1.0 Title and Approval Page

Document Title:	Ambient River Monitoring Program Quality Assurance Project Plan
Lead Organization:	Water Quality Planning Section
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Preparation Date (month/day/year):	June 7, 2002

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Signature / Date
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Signature / Date
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Signature / Date
Vincent Perelli, NHDES

USEPA Project Manager: _____
Signature / Date
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Signature / Date
Arthur Clark, US EPA Region I

USEPA State of NH Team Director: _____
Signature / Date
Carl Deloi, US EPA Region I

Document control number: USEPA will provide

2.0 Table of Contents and Document Format

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2.1 Document Control Format

The document control format is shown in the upper right hand corner of each page of this QAPP.

2.2 Document Control Numbering System

The revision number provided in the upper right hand corner of this QAPP is the basis for the document control numbering system of this QAPP. Recipients of copies of this QAPP are listed in Table 1 in Section 3.0. The Program Manager retains the controlled copy of this QAPP.

2.3 EPA-NE QAPP Worksheet #2

Please see the next page for Worksheet #2.

EPA-NE QAPP Worksheet #2

1. Identify Guidance used to prepare QAPP:

Format and content: Region I, EPA-NE Compendium of QAPP Requirements and Guidance, Final October 1999, and Attachment A, Region I, EPA-NE QAPP Manual. Draft, September, 1998.
Scale of content: EPA Requirements for Quality Assurance Project Plans, EPA QA/R-5. Interim final, November, 1999.

2. Identify EPA Program: Clean Water Act, Section 303(d) and 305(b), Surface Water Program

3. Identify approval entity: EPA-NE, State, or other: EPA-New England

4. Indicate whether the QAPP is a generic program QAPP or a project specific QAPP. (underline one)

5. List dates of scoping meetings that were held: none

6. List title of QAPP documents and approval dates written for previous site work, if applicable:

Title: NH Ambient Sampling Program QAPP

Approval Date: None --- Submittal Date: 02-12-96

7. List organizational partners (stakeholders) and connection with EPA and/or State:

None

8. List data users:

The Government and General Public of the State of New Hampshire

U.S. Environmental Protection Agency

9. If any required QAPP Elements (1-20), Worksheets and/or Required Information are not applicable the project, then circle the omitted QAPP Elements, Worksheets and Required Information on the attached Table. Provide an explanation for their exclusion below:

All QAPP elements are included in the Ambient River Monitoring Program QAPP.

Required EPA QA/R-5 QAPP Elements	Required EPA-NE QAPP Elements and Corresponding EPA-NE QAPP Sections	EPA-NE QAPP Worksheet #	Required Information
Project Management and Objectives			
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A5	5.0 Project Planning/Project Definition 5.1 Project Planning Meetings 5.2 Problem Definition/Site History and Background	8a 8b	-Project Scoping Meeting Attendance Sheet with Agenda and other Project Planning Meeting Documentation -Problem Definition/Site History and Background -EPA-NE DQO Summary Form -Site Maps (historical and present)
A6	6.0 Project Description and Schedule 6.1 Project Overview 6.2 Project Schedule	9a 9b 9c 9d 10	-Project Description -Contaminants of Concern and Other Target Analytes Table -Field and Quality Control Sample Summary Table -Analytical Services Table -System Designs -Project Schedule Timeline Table
A7	7.0 Project Quality Objectives and Measurement Performance Criteria 7.1 Project Quality Objectives 7.2 Measurement Performance Criteria	11a 11b	-Project Quality Objectives/Decision Statements -Measurement Performance Criteria Table
Measurement/Data Acquisition			
B1	8.0 Sampling Process Design 8.1 Sampling Design Rationale	12a 12b	-Sampling Design and Rationale -Sampling Locations, Sampling and Analysis Method/SOP Requirements Table -Sample Location Map

Required EPA QA/R-5 QAPP Elements	Required EPA-NE QAPP Elements and Corresponding EPA-NE QAPP Sections	EPA-NE QAPP Worksheet #	Required Information
B2, B6, B7, B8	9.0 Sampling Procedures and Requirements 9.1 Sampling Procedures 9.2 Sampling SOP Modifications 9.3 Cleaning and Decontamination of Equipment/Sample Containers 9.4 Field Equipment Calibration 9.5 Field Equipment Maintenance, Testing and Inspection Requirements 9.6Inspection and Acceptance Requirements for Supplies/Sample Containers	13 12b 14 15	-Sampling SOPs -Project Sampling SOP Reference Table -Sampling Container, Volumes and Preservation Table -Field Sampling Equipment Calibration Table -Cleaning and Decontamination SOPs -Field Equipment Maintenance, Testing and Inspection Table
B3	10.0 Sample Handling, Tracking and Custody Requirements 10.1 Sample Collection Documentation 10.1.1 Field Notes 10.1.2 Field Documentation Management System 10.2 Sample Handling and Tracking System 10.3 Sample Custody	16	-Sample Handling, Tracking and Custody SOPs -Sample Handling Flow Diagram -Sample Container Label (Sample Tag) -Chain-of-Custody Form and Seal
B4, B6, B7, B8	11.0 Field Analytical Method Requirements 11.1 Field Analytical Methods and SOPs 11.2 Field Analytical Method/SOP Modifications 11.3 Field Analytical Instrument Calibration 11.4 Field Analytical Instrument/ Equipment Maintenance, Testing and Inspection Requirements 11.5 Field Analytical Inspection and Acceptance Requirements for Supplies	17 18 19	-Field Analytical Methods/SOPs -Field Analytical Method/SOP Reference Table -Field Analytical Instrument Calibration Table -Field Analytical Instrument/Equipment Maintenance, Testing and Inspection Table

Required EPA QA/R-5 QAPP Elements	Required EPA-NE QAPP Elements and Corresponding EPA-NE QAPP Sections	EPA-NE QAPP Worksheet #	Required Information
B4, B6, B7, B8	12.0 Fixed Laboratory Analytical Method Requirements 12.1 Fixed Laboratory Analytical Methods and SOPs 12.2 Fixed Laboratory Analytical Method/SOP Modifications 12.3 Fixed Laboratory Instrument Calibration 12.4 Fixed Laboratory Instrument/ Equipment Maintenance, Testing and Inspection Requirements 12.5 Fixed Laboratory Inspection and Acceptance Requirements for Supplies	 20 21	-Fixed Laboratory Analytical Methods/SOPs -Fixed Laboratory Analytical Method/SOP Reference Table -Fixed Laboratory Instrument Maintenance and Calibration Table
B5	13.0 Quality Control Requirements 13.1 Sampling Quality Control 13.2 Analytical Quality Control 13.2.1 Field Analytical QC 13.2.2 Fixed Laboratory QC	 22a 22b 23a 23b 24a 24b	Sampling - Field Sampling QC Table - Field Sampling QC Table cont. Analytical - Field Analytical QC Table - Field Analytical QC Table cont. - Field Screening/Confirmatory Analysis Decision Tree - Fixed Laboratory Analytical QC Sample Table - Fixed Laboratory Analytical QC Sample Table cont.
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Required EPA QA/R-5 QAPP Elements	Required EPA-NE QAPP Elements and Corresponding EPA-NE QAPP Sections	EPA-NE QAPP Worksheet #	Required Information
Assessment/Oversight			
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D2	19.0 Verification and Validation Procedures	29a 29b 29c	-Data Evaluation Process -Data Validation Summary Table -Data Validation Modifications
D3	20.0 Data Usability/Reconciliation with Project Quality Objectives	30	-Data Usability Assessment

3.0 Distribution List and Project Personnel Sign-off Sheet

Table 1 shows all individuals receiving the approved QAPP, the QAPP revisions, and any amendments. A project personnel sign-off sheet is not included in this draft, but will be generated upon finalization of the QAPP. All individuals involved with the project will indicate their review of the QAPP prior to completing any work on this project.

Table 1[a]. QAPP Distribution List

QAPP Recipient Name	Title	Organization	Telephone Number
Vincent Perelli	NHDES Quality Assurance Manager	NHDES Planning Unit	603-271-8989
Rachel Rainey	Laboratory QA Officer	NHDES Laboratory	603-271-2993
Arthur Clark	USEPA Quality Assurance Officer	USEPA New England	617-918-1587
Warren Howard	USEPA Project Manager	USEPA New England	617-918-8374

[a]Based on EPA-NE Worksheet #3

4.0 Project Organization

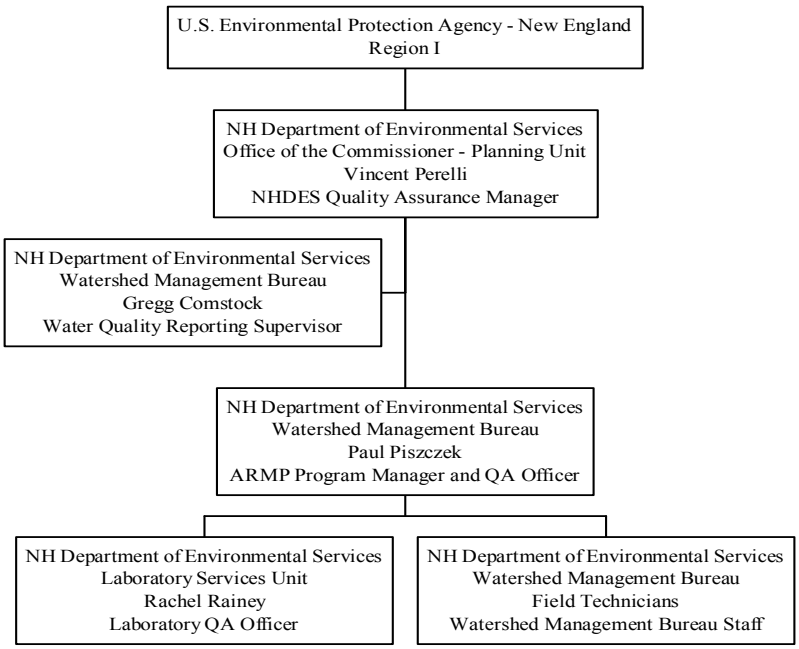
This section identifies the organizations and key personnel participating in the project and describes their specific roles, responsibilities, and qualifications. This section also explains communication pathways.

4.1 Project Organization Description and Chart

The Ambient River Monitoring Program (ARMP) is conducted through the NHDES Watershed Management Bureau, using staff of the Water Quality Planning Section (Figure 1). Paul Piszczek is the ARMP Manager, and is responsible for preparing and revising the ARMP QAPP. The Program Manager also serves as the Program QA Officer due to staff limitations. The Program Manager collaborates with Watershed Management Bureau staff in the design and implementation of the program during summer 2002, including the selection of sampling locations and logistical planning. The Program Manager and/or Water Quality Planning Section staff trains field technicians in proper water sampling and measurement techniques. Several individuals are responsible for field data collection, and include two field technicians. The field technicians are also responsible for entering data into the NHDES water quality database (STORET compatible). NHDES laboratory personnel are responsible for analyzing water samples for bacteria, nutrients, and metals. Rachel Rainey, NHDES Laboratory Services Unit, is the Laboratory QA Officer, and is responsible for reviewing and revising laboratory-related elements of the the QAPP. The Laboratory QA Officer also oversees QAPP implementation in the laboratory.

Water Quality Planning Section staff are responsible for compiling and analyzing data for decision-making purposes. Data are used by state and federal governments for identifying water pollution areas, and are the basis for the federal 303(d) list and 305(b) report. Other data users include staff of the U.S. Environmental Protection Agency and the general public.

Figure 1. Organizational chart for the NHDES Ambient River Monitoring Program.



4.2 Communication Pathways

The Program Manager is the primary contact for all staff involved with the ARMP. Dialogue exists between the Program Manager and Watershed Management Bureau staff regarding the design and implementation of the program, as it relates to the preparation of the 303(d) list and 305(b) report. The Program Manager provides direction to the field technicians throughout the data collection period, and is notified of any problems associated with data collection and/or analysis. Further direction is given regarding data entry. In consultation with the Laboratory QA Officer, the Program Manager delegates corrective actions. Results from the ARMP are transmitted to other Water Quality Planning Section staff to support the development of the 303(d) list and 305(b) report.

Modifications to Approved QAPP

EPA New England requires that all modifications to an approved QAPP be documented and submitted for approval in the same manner as the original QAPP. The following paragraphs document the procedures that will be followed when any project activity originally documented in this QAPP requires real-time modification to achieve project goals.

Modifications to the ARMP QAPP will be documented and reported to EPA New England according to the following procedures.

1. *Sampling/Monitoring Program Design*: The Program Manager consults other NHDES staff to discuss the need for modifications to the design. If modifications are necessary, the Program Manager revises the original QAPP and submits the revisions to EPA New England.
2. *Sample Collection Procedures*: The Program Manager consults other NHDES staff to discuss the need for modifications to the procedures. If modifications are necessary, the Program Manager revises the original QAPP and submits the revisions to EPA New England.
3. *Sample Analysis Procedures*: The Program Manager consults the Laboratory QA Officer to discuss the need for modifications to the procedures. If modifications are necessary, the Program Manager revises the original QAPP and submits the revisions to the EPA New England.
4. *Data Assessment and Reporting*: The Program Manager consults other NHDES staff to discuss the need for modifications to the procedures. If modifications are necessary, the Program Manager revises the original QAPP and submits the revisions to EPA New England.

4.3 Personnel Responsibilities and Qualifications

Several individuals are involved with the ARMP. Table 2 identifies project personnel and corresponding responsibilities.

4.4 Special Training Requirements/Certification

Training is required for water quality data collection, analysis, and data entry. The requirements are itemized in Table 3. Field technicians sign and date a training certification form that is retained by the Program QA Officer.

Table 2[a]. Personnel Responsibilities and Qualifications.

Name and Affiliation	Responsibilities	Education and Experience Qualifications
Paul Piszczek (Program Manager) NHDES Watershed Management Bureau	- Coordinates and participates in all activities of the ARMP - Prepares Ambient Program QAPP	M.S., Biology, 1994, Tennessee Technological University; B.S., Biology (Chemistry minor), 1992, Northland College; 10 years experience in water quality/fisheries
Rachel Rainey (Laboratory QA Officer) NHDES Laboratory Services	- Oversees laboratory QA/QC activities and identifies necessary corrective actions	B.S., Biochemistry (Microbiology minor), 1982, University of New Hampshire; 20 years chemistry experience
Field Technicians	- Collect water samples and document field conditions	Undergraduate students or recent graduates with coursework background in science (e.g., biology, environmental studies, chemistry)

[a]Based on EPA-NE Worksheet #6

Table 3[a]. Special Personnel Training Requirements

Project function	Description of Training	Training Provided by	Training Provided to	Location of Training Records
Water Sampling	Instrumentation procedures and water sample collection methods	Program Manager & NHDES- WMB personnel	Ambient Program Field Technicians	NHDES – Watershed Management Bureau Office
Data Entry	Computer software overview and data entry procedures	Program Manager	Ambient Program Field Technicians	NHDES – Watershed Management Bureau Office
Water Sample Analysis	Laboratory analytical procedures	QA Officer, NHDES Laboratory Services Unit	Laboratory Technicians	NHDES – Laboratory Services Unit

5.0 Project Planning/Project Definition

This section documents the project planning, identifies the environmental problem, defines the environmental questions that need to be answered, and provides background information.

5.1 Project Planning Meetings

To date, the planning process for the summer 2002 sampling component of the ARMP consisted of several internal scoping meetings, held during the summer and fall of 2001. Staff of the NHDES Watershed Management Bureau attended the meetings, including Paul Piszczek (Program Manager), Gregg Comstock (Water Quality Reporting Supervisor), Beth Malcolm (Volunteer River Assessment Program Coordinator), Phil Trowbridge (Coastal Watershed Scientist), and Paul Currier (NHDES Administrator). The historical aspects of the program, general attributes of the summer 2001 sampling approach, and current and future 303(d) list(s) and 305(b) report(s) were discussed at the meetings.

5.2 Problem Definition/Site History and Background

The rivers and streams of the State of New Hampshire receive drainage from multiple land use watersheds, which create diverse surface water quality conditions throughout the state. These conditions have varying implications for the support of aquatic life and human activities, which are directly related to state surface water quality standards. Water quality conditions relative to surface water quality standards have been documented through various water quality monitoring efforts, and results have depicted a wide range of water quality relative to physical, chemical, and biological parameters such as temperature, turbidity, dissolved oxygen, pH, metals, and bacteria. Water quality is spatially and temporally dynamic, and generally reflects land and water management practices.

The ARMP is administered through the NHDES to determine whether the rivers and streams of New Hampshire meet state surface water quality standards. The program is ongoing, as instituted pursuant to Section 303 and Section 305 of the Federal Water Pollution Control Act, which authorizes states (in this case, the State of New Hampshire) to adopt surface water quality standards and report the quality of surface waters, respectively. The ARMP is currently the primary mechanism for documenting water quality conditions in rivers and streams throughout the state.

The ARMP continues to use physicochemical water quality parameters to determine whether rivers and streams in New Hampshire meet state surface water quality standards. This is based on the State's use of physicochemical parameters as the foundation of surface water quality standards. Most samples are collected under near-limiting ambient conditions (e.g., low stream flow) that typically occur during the summer months, although sampling of rivers and streams in coastal watersheds occurs from March through December. Monitoring efforts during summer 2002 involve an increased sampling frequency of rivers and streams identified as impaired or potentially impaired on the 303(d) list and/or 2000 305(b) Report. In addition, samples are collected from 17 monitoring stations for use in trend analysis. These stations were established during the late 1980s under national water quality programs: 12 stations represent National Water Quality Surveillance Stations (NWQSS) and five stations represent Primary Monitoring Network (PMN) stations. Sampling locations are depicted on maps provided in Appendix A.

6.0 Project Description and Schedule

This section presents a general overview of the activities that will be performed during this project and a schedule for implementation.

6.1 Project Overview

The ARMP is designed to determine whether rivers and streams throughout New Hampshire meet state surface water quality standards and support designated uses. The program includes several components: (1) planning and design; (2) field data collection; (3) laboratory analysis; and (4) data synthesis. The end product is a data set used to determine whether rivers or streams are impaired or potentially impaired, based on legislative surface water quality standards and designated uses (e.g., swimming, fishing, support of aquatic life). This serves as the basis for the federal 303(d) list and 305(b) report, from which impaired or potentially impaired waters are targeted for additional, detailed study. Data collection during the summer 2002 monitoring program will target potentially impaired waters that were identified during previous sampling years. The purpose is to increase the sampling frequency to confirm impairment status. Furthermore, samples are collected from 17 monitoring stations, as described in Section 5.2, above.

Sampling tasks: Several analytical parameters are included in the ARMP (Table 4), and their use in the program is justified relative to the specific uses of a waterway. For example, elevated levels of *Escherichia coli* bacteria present a public health concern when a particular waterbody is used for swimming and/or bathing. Depressed dissolved oxygen and pH, high/low temperature, elevated turbidity levels present an environmental concern for the development and/or maintenance of fish and benthic macroinvertebrate communities; this may consequently affect the use of a particular waterway for recreational fishing.

Water samples are collected during the summer months under low flow, high temperature conditions, as these conditions are assumed to represent the limiting conditions of most rivers and streams during the year. In addition, rivers and streams receive greatest recreational use during this period. Sampling stations are generally selected relative to the proximity to potential pollution sources (e.g., agricultural areas, point source outfalls, etc.). The number of samples collected is based on statistical guidance for determining whether rivers and streams are impaired. Sampling methods include the use of field instrumentation and glass/plastic sample storage bottles; storage bottles are appropriately labeled with station name, date and time of sample collection, parameter of interest, and initials of field crew. All samples are collected during the morning and early afternoon hours, with all sampling information documented on field data sheets at the time of sampling.

For tables based on EPA-NE Worksheets #9b and #9c, please see Sections 7.0 and 8.0, respectively.

Analysis tasks: Throughout the monitoring period, dissolved oxygen, temperature, pH, specific conductance, and turbidity are measured in the field, whereas water samples are analyzed in the laboratory for nutrients, metals, and bacteria (Table 4). Laboratory analytical methods consist of persulfate digestion (TP), block digestion followed by flow injection colorimetry (TKN), automated colorimetry (NO_3+NO_2), flow injection colorimetry (NH_3), and membrane filter (*E. coli*). Laboratory analytical services are provided by the State of New Hampshire, Department of Environmental Services Laboratory Services Unit. Specific analytical services are described in Table 4. Standard operating procedures (SOPs) for all field and laboratory analyses tasks are given in Appendix B.

Table 4[a]. Surface water analytical services table

Analyte	Laboratory contact or instrument and person responsible
LAB ANALYSIS	
TP NO_3+NO_2 TKN NH_3 Hardness Alkalinity TS TSS BOD_5 *E. coli* Aluminum Copper Lead Zinc Chlorophyll *a*	NHDES Chemistry Laboratory 6 Hazen Drive, Concord NH 03304 Rachel Rainey, 603-271-2993
FIELD ANALYSIS	
Water Temperature Dissolved oxygen pH Specific Conductance Turbidity All field parameters	Water Temperature and Dissolved Oxygen: *YSI Model 52* pH: *Orion Model 250A Meter and Triode Model 91-57BN Electrode* Specific Conductance: *YSI Model 30* Turbidity: *LaMotte Model 2020* *Hydrolab DataSonde 4a* Paul Piszczek, 603-271-2471

[a]Based on EPA-NE Worksheet #9d

Quality control tasks: Field water quality instrumentation and laboratory analytical instrumentation are calibrated according to manufacturer's specifications prior to all field measurements and laboratory analysis. Sample bottles are appropriately prepared (e.g., rinsed, sterilized, etc.) prior to sample collection. Duplicate samples are analyzed at a frequency of 10% or more for field measurements. A complete description of quality control tasks is included in Section 13.0.

Secondary data: Data collected through the NHDES Volunteer River Assessment Program (VRAP) may serve as secondary data for the ARMP. The data may be used to determine the need for additional sampling locations. For example, if data from the VRAP show potential water quality problems at particular sampling locations, the ARMP Manager may target those sites for additional data collection.

Data management tasks: Field data are recorded on field data sheets, whereas laboratory data are recorded in laboratory bench book. All data sheets are returned to the Water Quality Planning Section office and retained in a three-ring binder. All data are entered into the NHDES water quality database for use in surface water assessments. All entered data are printed and checked against the field data sheets and laboratory bench book to ensure accuracy.

Documentation and records: Field data sheets are used on a daily basis throughout the data collection period; field data and general field notes written on the data sheets. A site description sheet is also used during the data collection period. A field equipment checklist provides guidance on necessary field equipment prior to most field sampling trips. The data are incorporated in the federal 303(d) list and

305(b) report, from which impaired or potentially impaired waters are targeted for additional, detailed study. A complete description of documentation and records are included in Section 15.0.

Data packages: Data packages are not created by the ARMP for the purposes of 303(d) listing and 305(b) reporting. However, data are submitted when requested by the public.

Assessment/Audit tasks: Assessments and audits are conducted for the program throughout the year according to Chapter 9 of the NHDES Quality Management Plan (QMP). Duplicate/replicate samples are analyzed at a frequency exceeding ten percent. A QA/QC report is prepared at the end of each year.

Data verification and validation tasks: Data are verified by referencing replicate samples, reviewing critical ranges, reviewing consistency of spiked samples, and reviewing duplicate samples. The data are screened for outliers, with outliers being highlighted and examined to determine the origin of the deviation. Data are also compared with existing and historical data from individual sampling locations. A complete description of data verification and validation tasks and procedures are included in Sections 18.0 and 19.0.

Data usability tasks: Data usability is directly related to verification and validation, where only valid data are used in the ARMP. Section 20.0 includes a complete description of data usability assessments.

6.2 Project Schedule

The ARMP consists of several activities that are completed throughout the year (Table 5). The due date of each deliverable is directly related to the amount of effort necessary to complete each activity, including the occurrences of delays. The Program Manager notifies all project participants of any delays associated with each activity. For example, data collection occurs during dry and wet weather conditions. However, the Program Manager will notify field data collection staff of extreme weather events (e.g., severe thunderstorms) that may create unsafe working conditions, and therefore delay data collection.

Table 5[a]. Project Schedule Timeline

Activity	Dates (MM/DD/YYYY)[b]		Deliverable	Deliverable Due Date
	Anticipated Date(s) of Initiation	Anticipated Date(s) of Completion		
Plan Ambient River Monitoring Program	October 1	May 31	--	--
Revise QAPP, as necessary	January 2	May 31	QAPP Document	May 31
Collect Field Data	June 1	September 15	Preliminary Water Quality Data Set	October 1
Analyze Water Samples at Laboratory	June 1	November 15	Preliminary Water Quality Data Set	November 30
Verify/Validate Data	December 1	December 31	Final Unconsolidated Comprehensive Water Quality Data Set	January 15
Data Synthesis	January 15	March 15	Final Consolidated Comprehensive Water Quality Data Set	March 15

[a]Based on EPA-NE Worksheet #10
[b]Year is not specified, since the ARMP is ongoing from year to year

Activities related to data verification and synthesis succeeds the data collection phase. Any delays associated with data verification and synthesis (e.g., laboratory and/or computer complications) are reported to the Program Manager. The Program Manager subsequently reports delays to the remainder of the Water Quality Planning Section and EPA-NE, and the schedule for data reporting is revised accordingly.

The ARMP initiates data collection during the first week of June of each calendar year. The end product of the program for each specific year is a data set used to determine whether a river or stream is impaired or potentially impaired, based on surface water quality standards and designated uses. This product is delivered on or before March 15 of every year.

7.0 Project Quality Objectives and Measurement Performance Criteria

This section documents the environmental decisions that need to be made and the level of data quality needed to ensure that the decisions are based on sound data.

7.1 Project Quality Objectives

Data from the ARMP are the basis of the federal 303(d) list and 305(b) report, which are prepared by the Water Quality Section of the NHDES Watershed Management Bureau. The 303(d) list shows all rivers and streams whose status is considered impaired or potentially impaired. The 305(b) report is submitted to Congress to provide information on the quality of New Hampshire surface waters. Impaired or potentially impaired waters are subsequently targeted for additional, detailed study. The data are also used to satisfy public requests for information relative to the quality of recreational waterways and waterways adjacent to property. Thus, the physical, chemical, and bacteriological characteristics of New Hampshire surface waters are depicted using numerous parameters, including temperature, turbidity, dissolved oxygen, pH, *Escherichia coli*, metals, and nutrients. These parameters are used to determine whether rivers and streams in New Hampshire meet legislative surface water quality standards, and support designated uses and aquatic life.

The use of ARMP data, as described above, inherently requires accurate data collection and documentation. Data are collected during summer months, when rivers and streams typically experience near-limiting ambient conditions (e.g., low stream flow). Rivers and streams included in the program generally represent statewide river and stream water quality characteristics. However, target waterways for 2002 include those found to be impaired or potentially impaired during previous ARMP efforts.

Trained personnel of the Water Quality Planning Section of the NHDES Watershed Management Bureau collect data using calibrated field water quality instrumentation and collect water samples for laboratory analysis. Personnel from the Laboratory Services Unit of the NHDES analyze and report laboratory data. Validated data are compared with state surface water quality standards to determine compliance. All field and laboratory methods are documented in Appendix B.

7.2 Measurement Performance Criteria

Several performance criteria are included to augment the quality of data collected and reported by the ARMP. These criteria are listed in Table 6, and are briefly described below.

7.2.1 Precision

Precision is calculated for field and laboratory measurements through sample duplicates (environmental variability) and measurement replicates (instrumental variability), and is calculated for each sampling day. For field and laboratory duplicates, data retention for water quality assessment purposes is contingent on compliance with a parameter-specific (Table 6) relative percent difference (RPD) as derived from equation 1, below.

(1)
$$RPD = \frac{|x_1 - x_2|}{\frac{x_1 + x_2}{2}} \times 100\%$$

where x_1 is the original sample concentration
x_2 is the duplicate sample concentration

Precision calculations in the laboratory are derived from duplicate sample analysis, where duplicate sample frequency varies according to analyte (e.g., one duplicate for every eight total phosphorus samples) (Table 20 through Table 34, Section 13.2.2). Precision is expressed as ranges (i.e., calculation of difference between actual sample and duplicate sample).

Table 6. Measurement Performance Criteria for Surface Water Samples

Analytical Parameter	Analytical Method/ SOP Reference	Measurement Performance Criteria			QC Sample and/or Activity Used to Assess Measurement Performance
		Precision	Accuracy	Sensitivity	
Total phosphorus	B-1	RPD ≤ 30%			Field duplicates
		Range 0-0.007			Lab duplicates
			$r^2 \geq 0.995$		Initial calibration
			±10% of 0.1 mg/l		ICV[a]
			77-119%		LFM recovery
				< ½ PQL	Annual calculation of MDL
NO_3+NO_2	B-2	RPD ≤ 15%			Field duplicates
		Range 0.00-0.23			Lab duplicates
			±10% of 2.5 mg/l		ICV
			92.7-108.1%		LFM recovery
				<1/10 PQL	Annual calculation of MDL
TKN	B-3	RPD ≤ 15%			Field duplicates
		Range 0.00-0.007			Lab duplicates
			±10% of 3.5 mg/l		ICV
			75-119%		LFM recovery
				1 PQL	Annual calculation of MDL
NH_3	B-4	RPD ≤ 15%			Field duplicates
		Range 0.00-0.36			Lab duplicates
			±10% of 8.22 mg/l		ICV
			84-119%		LFM recovery
				<1/6 PQL	Annual calculation of MDL
BOD_5	B-5	RPD ≤ 15%			Field duplicates
		Range 0.00-0.38			Lab duplicates
			88.7-131%		LFM recovery
			±10% of 4.8 mg/l		Laboratory control sample
Hardness	B-6	RPD ≤ 15%			Field duplicates
		Range 0.00-1.51			Lab duplicates
			±10% of 38.2 mg/l		ICV
			84-114%		LFM recovery
				<1/10 PQL	Annual calculation of MDL
Alkalinity	B-7	RPD ≤ 15%			Field duplicates
		Range 0.00-0.26			Lab duplicates
			±10% of 50 mg/l		ICV
				<1/4 PQL	Annual calculation of MDL

Table 6 (continued). Measurement Performance Criteria for Surface Water Samples

Analytical Parameter	Analytical Method/ SOP Reference	Measurement Performance Criteria			QC Sample and/or Activity Used to Assess Measurement Performance
		Precision	Accuracy	Sensitivity	
Total Solids	B-8	RPD ≤ 15%			Field duplicates
		Range 0-10.6			Lab duplicates
			±10%		Laboratory control sample
Total Suspended Solids	B-9	RPD ≤ 15%			Field duplicates
		Range 0.0-7.9			Lab duplicates
			±10%		Laboratory control sample
E. coli Aluminum	B-10, B-11 B-6	RPD ≤ 50% if maximum of either of two samples = 300 cts/100 ml; RPD ≤ 20% if maximum of either of two samples ≥ 406 cts/100 ml			Field duplicates
			0 counts/100 ml		Lab blanks
		RPD ≤ 15%			Field duplicates
Aluminum	B-6	Range 0.000-0.228			Lab duplicates
			±10% of 2 mg/l		ICV
Copper	B-12		94-109%		LFM recovery
				<1/3 PQL	Annual calculation of MDL
		RPD ≤ 15%			Field duplicates
		TBD			Lab duplicates
				TBD	ICV
Lead	B-12		TBD		LFM recovery
				<1/10 PQL	Annual calculation of MDL
		RPD ≤ 15%			Field duplicates
		Range 0.0000-0.0004			Lab duplicates
			±10% of 0.02 mg/l		ICV
Zinc	B-12		79-109%		LFM recovery
				<1/10 PQL	Annual calculation of MDL
		RPD ≤ 15%			Field duplicates
		Range 0.000-0.035			Lab duplicates
			±10% of 0.02 mg/l		ICV
			74-118%		LFM recovery
Chlorophyll *a*	B-13	RPD ≤ 15%			Field duplicate
			N/A-Back correction only		Instrument blank
Temperature	B-14	RPD ≤ 5%			Field duplicates

Table 6 (continued). Measurement Performance Criteria for Surface Water Samples

Analytical Parameter	Analytical Method/ SOP Reference	Measurement Performance Criteria			QC Sample and/or Activity Used to Assess Measurement Performance
		Precision	Accuracy	Sensitivity	
Dissolved Oxygen	B-14	RPD ≤ 5%			Field duplicates
		RPD ≤ 5%			Measurement replicates
			± 2.0% of saturation[b]		Meter review[c]
pH	B-15	RPD ≤ 0.2 std units			Field duplicates
		RPD ≤ 0.2 std units			Measurement replicates
			± 0.2 standard units		Known buffer (pH = 6.0)
Specific Conductance	B-16	RPD ≤ 5%			Field duplicates
		RPD ≤ 5%			Measurement replicates
			± 5.0 µS/cm		Field blank
		RPD ≤ 5%			Field duplicates
Turbidity	B-17	RPD ≤ 5%			Measurement replicates
			± 1.0 NTU		Field blank

[a]ICV = Initial calibration verification
[b]Relative accuracy
[c]meter review = replacing sensor in storage chamber and recording measurement, with subsequent comparison to initial calibration value

7.2.2 Accuracy

Accuracy for field measurements is determined for all field parameters except temperature (Table 6). Field blanks are measured for specific conductance and turbidity, whereas a known buffer is used to determine the accuracy of the pH meter. Temperature sensors do not require accuracy determinations, as the sensors are tested in the laboratory prior to the commencement of the monitoring period.

Accuracy limits of laboratory analyses are defined through independent calibration verifications and continuing calibration verifications of laboratory control samples (Table 20 through Table 34). Spiked samples are used to determine matrix interference. Complete definitions of accuracy are provided in the SOPs for individual parameters (Appendix B).

7.2.3 Representativeness

The ARMP aims to identify and/or confirm the occurrence of impaired or potentially impaired waterways in the State of New Hampshire. Many water quality parameters are spatially and temporally dynamic, and experience near-limiting ambient conditions (e.g., low stream flow, warm water temperature) typically during the summer. For example, dissolved oxygen concentrations are typically least during the early morning hours in response to photosynthetic/respiration cycles. It is assumed any waterway attaining the state surface water quality standards for dissolved oxygen during the early morning hours will attain standards throughout other times of the day, although this is not true in every case. Based on this assumption, water samples are collected between the hours of 07:00 and 13:00 during June, July, August, and early September. Spatial dynamics relate to many attributes, including land use,

geology, and the river channel. Therefore, sampling locations are established in agricultural, urban, and forest areas with variable channel characteristics throughout the state.

7.2.4 Comparability

The ARMP employs field and laboratory instrumentation and methodology that are consistent among sampling locations. Although field measurements are made at each site on different days throughout the summer, measurements are made during the same time of day. In addition, water samples are collected and transported to the Laboratory Services Unit of the NHDES during similar times of day. This is consistent with procedures used during previous monitoring activities.

7.2.4 Sensitivity

The ARMP is specifically designed to determine whether rivers and streams meet state surface water quality standards. Therefore, the field and laboratory instrumentation used in the program are capable of analyzing water samples that do not attain water quality standards. Specific detection limits are provided in Table 7.

7.2.5 Quantitation Limits

The analytical method, analytical/achievable method detection limit, and the analytical/achievable laboratory quantitation limits for this project are shown in Table 7. To date, quantitation limits have not been defined for chlorophyll *a*, and are not provided in Table 7, below. Upon definition of the quantitation limits for chlorophyll *a*, NHDES will transmit a letter to EPA-NE for the purposes of updating Table 7 of this QAPP. A copy of the letter will also be transmitted to the NHDES Quality Assurance Manager.

Table 7[a]. Surface Water Target Analytes and Reference Limits (2002 MDL and RDL Data)

Analyte	Analytical method (See Appendix B for SOPs)	Analytical/Achievable Method Detection Limit	Analytical/Achievable Laboratory Quantitation Limit
Laboratory Analysis			
Total phosphorus	EPA 365.2; Lachat QuikChem Method 10-115-01-1-F	0.0022 mg/L	0.005 mg/l
NO_3+NO_2	EPA-600/R-93-100, Method 353.2; Lachat 10-107-04-1-A	0.003 mg/L	0.05 mg/l
TKN	EPA-600/4-79-020, Method 351.2; Lachat Method #10-107-06-2-E	0.095 mg/L	0.25[b] mg/l
NH_3	Standard Method 4500-NH3-B (APHA, 1995); 1.Lachat Method #10-107-06-1-A	0.078 mg/L	0.25[b] mg/l
BOD_5	EPA 600/4-79-020, Method 360.1; Standard Method 5210 B (APHA, 1995)	N/A	<3[b] mg/l
Hardness	EPA 200.7	0.0868 mg/l	2.9 mg/l
Alkalinity	EPA 600/4-79-020, Method 310.1; Standard Method 2320 B (APHA, 1995)	1.18 mg/l	5 mg/l

Table 7 (continued). Surface Water Target Analytes and Reference Limits (2002 MDL and RDL Data)

Analyte	Analytical method (See Appendix B for SOPs)	Analytical/Achievable Method Detection Limit	Analytical/Achievable Laboratory Quantitation Limit
Laboratory Analysis			
Total Solids	EPA 600/4-79-020, Method 160.3; Standard Method 2540 B (APHA, 1995)	N/A	1[b] mg
Total Suspended Solids	EPA 600/4-79-020, Method 160.2; Standard Method 2540 D (APHA, 1995)	N/A	1[b] mg
E. coli	Membrane Filter Procedure, EPA 600/4-85/076; Standard Method 9213D.3 (APHA, 1995)	0+ cts/100 mL (depends on dilution and sample volume)	0+ cts/100 mL (depends on dilution and sample volume)
Aluminum	EPA 200.7	0.0141 mg/l	0.05 mg/l
Copper	EPA 200.8	0.1061 µg/l	2[b] µg/l
Lead	EPA 200.8	0.068 µg/l	1 µg/l
Zinc	EPA 200.8	0.245 µg/l	5 µg/l
Chlorophyll *a*	Standard Methods (1998) Method 10200H	TBD[c]	TBD
Field Measurement			
Temperature	YSI Model 52	--	--
Dissolved oxygen	YSI Model 52	0.1 mg/L; 0.1% saturation	--
pH	Orion Model 250A Meter and Triode Model 91-57BN Electrode	--	--
Specific Conductance	YSI Model 30	0.6 µS/cm	--
Turbidity	Lamotte Model 2020	0.01 NTU	--
Temperature	Hydrolab DataSonde 4a	--	--
Dissolved oxygen	Hydrolab DataSonde 4a	0.2 mg/L; 0.2% saturation	--
pH	Hydrolab DataSonde 4a	--	--
Specific Conductance	Hydrolab DataSonde 4a	0.6 µS/cm	--
Turbidity	Hydrolab DataSonde 4a	0.01 NTU	--

[a]Based on EPA-NE Worksheet #9b
[b]Differs from limit published in SOP, per verbal agreement with NHDES Laboratory Services
[c]To be determined – in consultation with EPA-NE

7.2.6 Completeness.

During summer 2002, data collection exceeds 67% from the 17 trend monitoring stations, whereas no less than 75% of the data are collected from the confirmation monitoring stations (Table 8). In contrast, any amount of data collected during summer 2002 can be used as public information, although 75%-100% is the target proportion of data for public use.

8.0 Sampling Process Design (Experimental Design)

This section describes the sampling rationale and procedures.

8.1 Sampling Design Rationale

The summer 2002 ARMP is designed to increase the sampling frequency at locations with potential water quality problems, as identified by previous ARMP sampling efforts. In addition, the monitoring approach includes data collection from 17 fixed stations, where data have been collected annually during the past decade. Table 8 lists the types of activities conducted by the ARMP during summer 2002, including trend monitoring and confirmation monitoring. A sampling location map, and a list of the sampling locations, station identification codes, and river names are provided in Appendix A.

Stations targeted for confirmation monitoring during summer 2002 are those stations included in the 2000 State of New Hampshire 305(b) report to Congress. These stations were selected during the mid-late 1990s using a targeted approach. NHDES is currently developing a comprehensive methodology for assessing water quality throughout the state, and has preliminarily determined that increasing sampling frequency will increase the confidence when making water quality impairment decisions. Nearly 150 sites have been identified as potential locations of concern on particular rivers, streams, and brooks, ranging in character from elevated bacteria levels and metals concentrations to depressed dissolved oxygen levels. The NHDES evaluates water quality according to established narrative and numeric surface water quality standards. The target parameters for confirmation monitoring, as shown in Table 8, below, include *Escherichia coli*, dissolved oxygen, aluminum, copper, lead, and zinc. For dissolved oxygen, increased frequency of surface water grab sampling (*in situ*) is augmented through the use of automated, programmable water quality instrumentation (e.g., Hydrolab® multiprobe units). The units are record data at 15-minute intervals during a five-day period to determine diurnal dissolved oxygen dynamics.

Trend monitoring stations were adopted by the State of New Hampshire as a component of a national water quality monitoring program during the late 1980s and early 1990s, and target four of the five principal watersheds in New Hampshire. These watersheds include the Connecticut River, Merrimack River, Androscoggin River, and Saco River. Although all trend monitoring stations were selected to document water quality, and detect any changes, through time, several locations (e.g., 1-And, 1-Sac, 1-Mer, etc.) were specifically established to characterize water quality conditions at state borders. The parameters sampled at the 17 trend monitoring stations were selected to represent various aspects of water quality, particularly in the context of the narrative and numeric standards established for surface water in New Hampshire. Trend monitoring stations are fixed stations reviewed annually by the Water Quality Planning Section for adequacy and representativeness. Ongoing data collection from the 17 trend monitoring stations is necessary to continue the development of the comprehensive trend monitoring data set. The data set constitutes one of the largest river water quality data sets, which includes routine sampling at fixed stations, available through NHDES.

Table 8[a]. Surface Water Field Sample Summary

Analyte	Monitoring Type[b]	Sample Type	Number of sampling stations	Sampling Frequency	Number of field duplicates	Total Number of samples to lab
Total phosphorus	Trend	Surface Grab	17	Once per month in June, July, August	6	57
Nitrate+nitrite (NO_3+NO_2)	Trend	Surface Grab	17	Once per month in June, July, August	6	57
TKN	Trend	Surface Grab	17	Once per month in June, July, August	6	57
Ammonia	Trend	Surface Grab	17	Once per month in June, July, August	6	57
BOD_5	Trend	Surface Grab	17	Once per month in June, July, August	6	57
Hardness	Trend	Surface Grab	17	Once per month in June, July, August	6	57
Alkalinity	Trend	Surface Grab	17	Once per month in June, July, August	6	57
Total Solids	Trend	Surface Grab	17	Once per month in June, July, August	6	57
Total Suspended Solids	Trend	Surface Grab	17	Once per month in June, July, August	6	57
E. coli	Trend	Surface Grab	17	Once per month in June, July, August	6	57
Aluminum	Trend	Surface Grab	17	Once per month in June, July, August	6	57
Copper	Trend	Surface Grab	17	Once per month in June, July, August	6	57
Lead	Trend	Surface Grab	17	Once per month in June, July, August	6	57
Zinc	Trend	Surface Grab	17	Once per month in June, July, August	6	57
Temperature	Trend	Surface Grab	17	Once per month in June, July, August	6	57
pH	Trend	Surface Grab	17	Once per month in June, July, August	6	-
Dissolved oxygen	Trend	Surface Grab	17	Once per month in June, July, August	6	-
Specific Conductance	Trend	Surface Grab	17	Once per month in June, July, August	6	-
Turbidity	Trend	Surface Grab	17	Once per month in June, July, August	6	-
Chlorophyll *a*	Trend	Surface Grab	17	Once per month in June, July, August	6	-
E. coli	Confirmation	Surface Grab	125	Twice per month in June, July, August	36	350
Dissolved oxygen	Confirmation	Surface Grab	35	Twice during summer (Once every 5-6 weeks)	8	-
Dissolved oxygen	Confirmation	Automated measurement (surface)	25	Once during summer for a 5-day continuous period	-	-
Aluminum	Confirmation	Surface Grab	2	Twice during summer (Once every 5-6 weeks)	1	5
Copper	Confirmation	Surface Grab	6	Twice during summer (Once every 5-6 weeks)	2	14
Lead	Confirmation	Surface Grab	2	Twice during summer (Once every 5-6 weeks)	1	5
Zinc	Confirmation	Surface Grab	8	Twice during summer (Once every 5-6 weeks)	2	18

[a]Based on EPA-NE Worksheet #9c
[b]Trend = Collected from stations established under national water quality programs; Confirmation = Collected from stations where additional samples are needed for statistically based water quality assessments

9.0 Sampling Procedures and Requirements

This section describes in detail how samples will be collected. Use of field analytical equipment is discussed in Section 11.0.

9.1 Sampling Procedures

The ARMP uses a routine, standardized approach to collecting water quality data. This approach increases consistency among samplers, facilitates the collection of accurate and precise data, increases the representativeness of samples, and augments data comparability.

All sampling activities, including field measurements and water sample collection, are conducted between 7:30 a.m. and 14:30 p.m., Monday through Friday. All field measurements and samples collected for laboratory analyses are collected using a two-gallon bucket noted in the SOP in Appendix B. The bucket is filled to at least one-half of its capacity, which ensures sufficient volume for all field measurements and sample storage containers. Samples for laboratory analysis are immediately transferred to individual sample storage containers (i.e., polyethylene or glass bottles), appropriately preserved, and stored on ice prior to the measurement of field parameters (Table 9). Sample collection, preservation, and storage procedures are followed according to the SOP in Appendix B. Field measurements are subsequently recorded from the water collected in the bucket for temperature, dissolved oxygen, pH, turbidity, and specific conductance (Table 10). Any comments relevant to the sampling event (e.g., sampling and/or instrumentation problems) are documented on field data sheets prior to traveling to the next sampling location. This procedure is repeated at all scheduled sampling locations for a particular day. All water samples are transported to the laboratory after the final site has been sampled, no later than 2:30 p.m. (unless approved by the Program Manager).

Table 9[a]. Sample locations and requirements

Analytical parameter	Collection method	Sampling SOP (Appendix)	Sample volume	Container size and type	Preservation requirements	Max. holding time (preparation and analysis)
Total phosphorus	Surface Grab	B-1	250 ml	250 ml brown polyethylene	H_2SO_4 to pH<2, light protected, chilled to 4°C	28 days
Nitrate+nitrite (NO_3+NO_2)	Surface Grab	B-2	50 ml	500 ml white polyethylene	chilled to 4°C	48 hours
TKN	Surface Grab	B-3	250 ml	250 ml brown polyethylene	H_2SO_4 to pH<2, chilled to 4°C	28 days
Ammonia	Surface Grab	B-4	250 ml	250 ml brown polyethylene	H_2SO_4 to pH<2, chilled to 4°C	28 days
BOD_5	Surface Grab	B-5	500 ml	500 ml polyethylene or glass	chilled to 4°C	48 hours
Hardness	Surface Grab	B-6	500 ml	500 ml LDPE or HDPE	HNO_3 to pH<2, chilled to 4°C	6 months
Alkalinity	Surface Grab	B-7	100 ml	100 ml polyolefin or glass	chilled to 4°C	14 days
TS	Surface Grab	B-8	100 ml	100 ml polyethylene	chilled to 4°C	7 days
TSS	Surface Grab	B-9	100 ml	100 ml polyethylene	chilled to 4°C	7 days

Table 9 (continued). Sample locations and requirements

Analytical parameter	Collection method	Sampling SOP (Appendix)	Sample volume	Container size and type	Preservation requirements	Max. holding time (preparation and analysis)
E. coli	Surface Grab	B-10, B-11	100 ml	250 ml sterile white polyethylene	chilled to ≤ 10ºC	8 hours[b]
Aluminum	Surface Grab	B-6	500 ml	500 ml LDPE or HDPE	HNO_3 to pH<2, chilled to 4°C	6 months
Copper	Surface Grab	B-12	500 ml	500 ml LDPE or HDPE	HNO_3 to pH<2, chilled to 4°C	6 months
Lead	Surface Grab	B-12	500 ml	500 ml LDPE or HDPE	HNO_3 to pH<2, chilled to 4°C	6 months
Zinc	Surface Grab	B-12	500 ml	500 ml LDPE or HDPE	HNO_3 to pH<2, chilled to 4°C	6 months
Chlorophyll *a*[c]	Surface Grab	B-13	500 ml	500 ml opaque polyethylene	Unfiltered, dark, 4°C	24 hours
					Filtered, dark – 20°C	28 days
Temperature	in-situ measurement	B-14	NA	NA	NA	NA
Dissolved oxygen	in-situ measurement	B-14	NA	NA	NA	NA
pH	in-situ measurement	B-15	NA	NA	NA	NA
Specific Conductance	in-situ measurement	B-16	NA	NA	NA	NA
Turbidity	in-situ measurement	B-17	15 ml	15 ml, clear glass	NA	NA
Temperature	in-situ measurement (continuous)	B-18	NA	NA	NA	NA
Dissolved oxygen	in-situ measurement (continuous)	B-18	NA	NA	NA	NA
pH	in-situ measurement (continuous)	B-18	NA	NA	NA	NA
Specific Conductance	in-situ measurement (continuous)	B-18	NA	NA	NA	NA
Turbidity	in-situ measurement (continuous)	B-18	NA	NA	NA	NA

[a]Based on EPA-NE Worksheet #12b
[b]Maximum transport time is 6 hours; must begin analysis within 2 hours after receipt at laboratory[c]two-step process, with filtration occurring within 24 hours and analysis within 28 days; frozen storage before analysis

Table 10[a]. Project Sampling SOP Reference Table

SOP title, revision date and/or number	Reference number (Appendix)	Originating organization	Equipment used
Sampling: Ambient River Monitoring Program Standard Operating Procedures (SOP): Sampling – May 2002	B-19	NHDES	Plastic sample storage containers; plastic bucket
Washing: Lab SOP for sample storage containers	B-20	NHDES	Plastic sample storage containers
Cleaning: Ambient River Monitoring Program Standard Operating Procedures (SOP): [Sampling; Dissolved oxygen/Temperature; pH; Specific Conductance; Turbidity] – May 2002	B-14 - B-18	YSI Incorporated, Orion Research, Inc., Lamotte Co.	Electronic meters
Decontamination: Ambient River Monitoring Program Standard Operating Procedures (SOP): [Sampling; Dissolved oxygen/Temperature; pH; Specific Conductance; Turbidity] – May 2002	B-14 - B-18	YSI Incorporated, Orion Research Inc., Lamotte Co.	Electronic meters

[a]Based on EPA-NE Worksheet #13

9.2 Sampling SOP Modifications

Modifications to the sampling SOP are not necessary to meet the project quality objectives of the ARMP.

9.3 Cleaning and Decontamination of Equipment/Sample Containers

Cleaning and decontamination of field sampling equipment (e.g., sample storage containers) occurs in the laboratory prior to use, and are described in the SOP in Appendix B. Cleaning and decontamination of field analytical equipment is discussed in Section 11.

9.4 Field Equipment Calibration

The ARMP uses minimal field equipment for water sampling tasks, whereas multiple instruments are used for analytical tasks. Sample storage containers, a two-gallon bucket, a 30-meter tape measure, and 60-meter surveyors rope are the only pieces of equipment related to sampling (Table 11). Calibration is not necessary for this equipment. Thus, calibration and acceptance criteria are not described.

Table 11[a]. Field sampling equipment calibration table

Equipment name	Procedure and SOP Reference	Frequency of calibration	Acceptance criteria	Corrective action	Person responsible
Nutrient sample storage container	--	--	--	--	Laboratory QA Manager
Bacteria sample storage container	--	--	--	--	Laboratory QA Manager
Metals sample storage container	--	--	--	--	Laboratory QA Manager
Two-gallon sampling bucket	--	--	--	--	Field Technicians; Program Manager
30-meter tape measure; 60-meter surveyors rope	--	--	--	--	Field Technicians; Program Manager
Various lengths of cable	--	--	--	--	Field Technicians; Program Manager
Padlocks	--	--	--	--	Field Technicians; Program Manager

[a]Based on EPA-NE Worksheet #14

9.5 Field Equipment Maintenance, Testing and Inspection Requirements

The ARMP uses minimal field equipment for water sampling, whereas multiple instruments are used for analytical tasks. Sample storage containers, a two-gallon bucket, and a 30-meter tape measure are the only pieces of equipment related to sampling (Table 12). An SOP for preparing sample bottles is given in Appendix B. Equipment maintenance logs are retained in the Water Quality Planning Section office in Concord.

9.6 Inspection and Acceptance Requirements for Supplies/Sample Containers

The Program Manager and/or field technicians and Laboratory QA Manager examine the supplies and sample containers prior to use. Additional supplies and sample storage containers accompany the field technicians during sample collection in the event that contamination or damage of another container occurs. An SOP for preparing sample bottles is given in Appendix B.

Table 12[a]. Field Sampling Equipment Maintenance, Testing, and Inspection

Equipment name	Activity	Frequency of activity	Acceptance criteria	Corrective action	Person responsible
Nutrient, bacteria, metals sample storage containers	Maintenance (cleaning); Inspection	As necessary, prior to use	No visible internal contamination or external damage	If found contaminated or damaged prior to sampling, do not use. Use alternate sample container.	Rachel Rainey, Laboratory QA Manager
Two-gallon sampling bucket	Maintenance (cleaning); Inspection	As necessary, prior to use	No visible internal contamination or external damage	If found contaminated or damaged prior to sampling, do not use. Use alternate sample container.	Field Technicians; Program Manager
100-meter tape measure; 60-meter surveyors rope	Maintenance (cleaning); Inspection	As necessary, prior to use	No visible damage	If found damaged or illegible prior to sampling, do not use. Use alternate tape measure.	Field Technicians; Program Manager
Various lengths of cable	Maintenance; Inspection	As necessary, prior to use	No visible damage	If found damaged prior to sampling, do not use. Use alternate cable.	Field Technicians; Program Manager
Padlocks	Maintenance; Inspection	As necessary, prior to use	No visible damage	If found damaged prior to sampling, do not use. Use alternate cable.	Field Technicians; Program Manager

[a]Based on EPA-NE Worksheet #15

10.0 Sample Handling, Tracking and Custody Requirements

10.1 Sample Collection Documentation

The ARMP requires documentation of activities during data collection. All documentation is described in Sections 10.1.1 and 10.1.2, which ensures sample authenticity and data integrity.

10.1.1 Field Notes

The water quality data and associated comments are retained in a three-ring binder entitled "Ambient River Monitoring Program – Raw Field Data and Comments: *Year* (e.g., 2002)." The binder is used to retain the field data sheets after each sampling day. The data sheets are tabularized to include, but not limited to, Date, Time, Site ID, River Name, Weather, Dissolved Oxygen, Temperature, Specific Conductance, Turbidity, pH, and Comments. Appendix C contains a sample data sheet.

The three-ring binder is also used to retain formatted sheets for documenting the physical characteristics of the sampling sites. The site descriptions are qualitative descriptions that include, but are not limited to, site sketches, land use practices, river channel/water characteristics, and references to photographs.

10.1.2 Field Documentation Management System

Field documentation during each monitoring year includes water quality data, comments regarding any problems with instrumentation/sampling, and site descriptions. The water quality data and associated comments are retained in a three-ring binder (described in Section 10.1.1) entitled "Ambient River Monitoring Program – Raw Field Data and Comments: [*Year*] (e.g., 2002)". The binder also contains site description forms, which are retained indefinitely, and stored in the NHDES, Watershed Management Bureau, Water Quality Planning Section office in Concord, NH. The field data sheets are returned to the office on a daily basis for review by the Program Manager, and are inserted into the three-ring binder. The binder is archived prior to the commencement of the following monitoring season, and retained indefinitely in the Water Quality Planning Section office.

10.2 Sample Handling and Tracking System

All water samples are identified and tracked through documentation on field data sheets (Appendix C).

10.2.1 Field Tasks

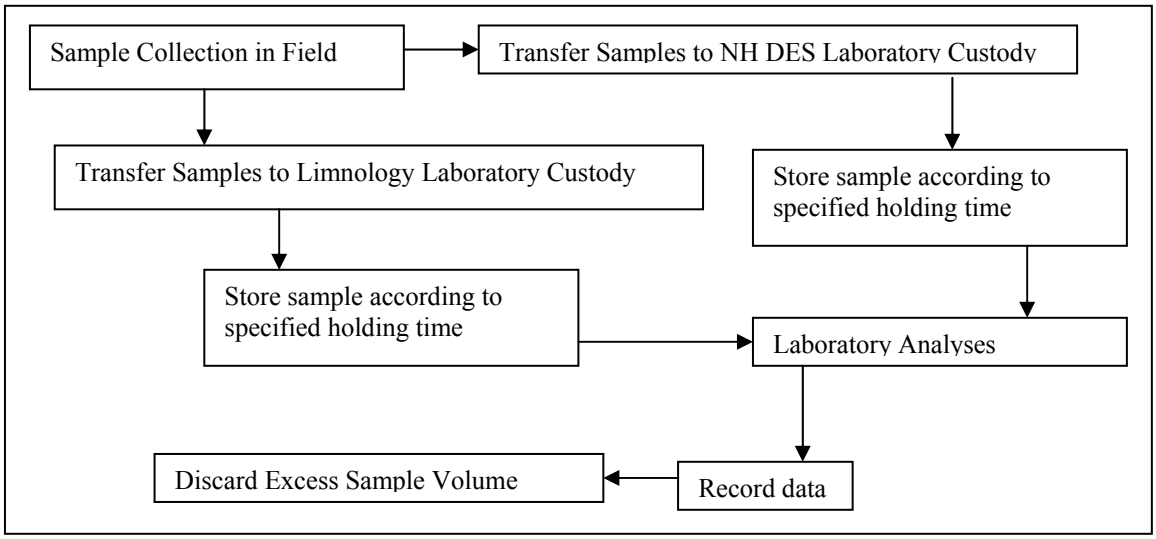
Prior to sample collection, all water sample storage containers are labeled with the following information: program name (e.g., ARMP), station identification number/name, date of sample collection, parameter of interest, preservation method (if any), initials of the field crew, and an appropriate number to indicate duplicate samples. Labeling prior to collection augments the legibility of the information, as condensation on the outside of a sample container generally occurs rapidly after water is placed in the container. However, the actual time of sample collection is written on the label immediately after the sample is collected.

10.2.2 Laboratory Tasks

The information recorded on the sampling container, as well as any other comments and/or notes, is transferred to a Login and Custody Sheet at the laboratory. This information is also transferred from the Login and Custody Sheet to the Laboratory Information Management System (LIMS) database, which provides a printed label for each logged sample. The printed label contains all information written on the

sample storage container, as well as the login date and time (See Appendix C). Water samples are analyzed for parameters listed in Table 6, Section 7.2. Any excess sample water is discarded in laboratory sinks, unless otherwise specified in the SOP in Appendix B.

Figure 2. Sampling Handling/Tracking/Custody Summary



10.3 Sample Custody

Water samples are collected in sample storage containers provided by the NHDES Laboratory Services unit. All samples are placed on cubed ice in a portable, opaque cooler immediately after collection, and transported to the laboratory. Samples are transported within six hours after collection, and prior to 2:30 p.m. due to the normal hours of operation of the laboratory. Special arrangements are made with the laboratory if samples are expected after 2:30 p.m.; samples are not collected during weekends.

Upon arrival at the laboratory, the field crew is responsible for completing a Login and Custody Sheet as supplied by the NHDES Laboratory Services Unit (Figure 2). The information recorded on the sampling container, as well as any other comments and/or notes, is transferred to the Login and Custody Sheet. Water samples are transferred from the cooler to a refrigerator at the laboratory after appropriate login procedures. However, samples for chlorophyll *a* are taken to the Limnology Center Laboratory immediately across the hall from the NHDES Laboratory. Samples are subsequently logged into a database by Limnology Center Laboratory staff (Appendix C). See Table 9 for sample container, volume, preservation information, and holding time information. The field crew is divested from responsibilities after completing the Login and Custody Sheet.

Laboratory personnel are subsequently responsible for transferring information from the Login and Custody Sheet to the LIMS, which provides a printed label for each logged sample. The label contains all information written on the sample storage container, as well as the login date and time. An example of the label is shown in Appendix C. Water samples are analyzed for parameters listed in Table 6, Section 7.2. The time of analysis is dependent on the holding time for the parameter of interest, where analyses are never conducted after the designated holding time expires. Analytical data are subsequently entered into a computer the LIMS, and printed on laboratory letterhead. Printed results are transmitted to the

Program Manager. Excess sample water is discarded in laboratory sinks, unless otherwise specified in the SOP in Appendix B.

11.0 Field Analytical Method Requirements

This section describes the analytical techniques used in the field to generate data for the ARMP. All field analytical methods, and SOPs used to meet measurement performance criteria and achieve project quantitation limits are documented in this section.

11.1 Field Analytical Methods and SOPs

The ARMP uses several water quality instruments for *in-situ* field measurements, and retrieves numerous water samples for various laboratory analyses (Table 13). Methods for all field activities (*in-situ* measurements and water sample collection) are documented as SOPs in Appendix B.

Table 13[a]. Field Analytical Method/SOP Reference Table

Reference Number (Appendix)	Title, Revision date or number	Definitive (D) or screening (S) data	Analytical parameter	Instrument	Origin of SOP (Organization)	Organization performing field analysis
B-14	Ambient River Monitoring Program Standard Operating Procedures (SOP): Dissolved Oxygen and Temperature – May 2002	D	Water Temperature	Electronic meter	YSI Incorporated	NHDES
B-14	Ambient River Monitoring Program Standard Operating Procedures (SOP): Dissolved Oxygen and Temperature – May 2002	D	Dissolved Oxygen	Electronic meter	YSI Incorporated	NHDES
B-15	Ambient River Monitoring Program Standard Operating Procedures (SOP): pH – May 2002	D	pH	Electronic meter	Orion Research, Inc.	NHDES
B-16	Ambient River Monitoring Program Standard Operating Procedures (SOP): Specific Conductance – May 2002	D	Specific Conductance	Electronic meter	YSI Incorporated	NHDES
B-17	Ambient River Monitoring Program Standard Operating Procedures (SOP): Turbidity – May 2002	D	Turbidity	Electronic meter	Lamotte Company	NHDES

Table 13 (continued). Field Analytical Method/SOP Reference Table

Reference Number (Appendix)	Title, Revision date or number	Definitive (D) or screening (S) data	Analytical parameter	Instrument	Origin of SOP (Organization)	Organization performing field analysis
B-18	Ambient River Monitoring Program Standard Operating Procedures (SOP): Hydrolab DataSonde 4a and MiniSonde	D	Temperature, Dissolved Oxygen; pH; Specific Conductance; Turbidity	Electronic meter	Hydrolab Corporation	NHDES

[a]Based on EPA-NE Worksheet #20

11.2 Field Analytical Method/SOP Modifications

Modifications to the field analytical methods or SOPs are not made for the ARMP during the monitoring period.

11.3 Field Analytical Instrument Calibration

All field instruments are calibrated prior to use according to manufacturer's specifications. Calibration methods for all instruments are summarized in Table 14 and documented in detail in Appendix B.

Table 14[a]. Field analytical equipment calibration table

Equipment name	Procedure and SOP Reference (Appendix)	Frequency of calibration	Acceptance criteria	Corrective action	Person responsible
YSI Model 52: Dissolved oxygen and temperature	B-14	Prior to each measurement (i.e., if seven measurements are made during the day, the meter is calibrated prior to each of the seven measurements)	± 0.2mg/l or ± 2% of saturation, whichever is greater	Recalibrate. If problem persists, inspect/replace batteries, membrane, and electrolyte. Recalibrate.	Paul Piszczek, Program Manager
Orion Model 250A Meter and Triode Model 91-57BN Electrode: pH	B-15	Prior to each measurement (i.e., if seven measurements are made during the day, the meter is calibrated prior to each of the seven measurements)	Slope value 92-102%	Recalibrate. If problem persists, inspect/replace batteries, replace buffers, ensure electrode is appropriately filled with filling solution. Recalibrate.	Paul Piszczek, Program Manager
YSI Model 30: Specific Conductance	B-16	Daily, prior to use	N/A	Turn off. Inspect/replace batteries. Turn on.	Paul Piszczek, Program Manager
LaMotte Model 2020: Turbidity	B-17	Prior to each measurement (i.e., if seven measurements are made during the day, the meter is calibrated prior to each of the seven measurements)	± 0.5 NTU	Recalibrate. If problem persists, inspect/replace batteries and standard solutions. Recalibrate.	Paul Piszczek, Program Manager
Hydrolab DataSonde 4a or MiniSonde: Dissolved Oxygen and Temperature	B-18	Prior to deployment	±0.2 mg/l	Recalibrate. If problem persists, replace membrane, and electrolyte. Recalibrate.	Paul Piszczek, Program Manager
Hydrolab DataSonde 4a or MiniSonde: pH	B-18	Prior to deployment	±0.2 std. units	Recalibrate. If problem persists, replace buffers, ensure electrode is appropriately filled with filling solution. Recalibrate.	Paul Piszczek, Program Manager
Hydrolab DataSonde 4a: Specific Conductance	B-18	Prior to deployment	±1% of range	Recalibrate. If problem persists, replace standard solution. Recalibrate.	Paul Piszczek, Program Manager
Hydrolab DataSonde 4a: Turbidity	B-18	Prior to deployment	±5% of range	Recalibrate, If problem persists, clean lenses, ensure fresh standard solution. Recalibrate.	Paul Piszczek, Program Manager

[a]Based on EPA-NE Worksheet #14

11.4 Field Analytical Instrument/Equipment Maintenance, Testing, and Inspection Requirements

This section describes the procedures and documentation activities that will be performed to ensure that all field analytical instrumentation and equipment are available and in working order when needed.

All instruments are inspected and tested during March and April of each monitoring year to ensure proper functionality. Instruments are cleaned and calibrated according to manufacturer's specifications, and placed in concomitantly in a sample chamber (e.g., bucket) to determine instrument agreement.

All field instruments are visually inspected prior to use during the summer monitoring season. Visual inspection also occurs on a daily basis prior to each use. This includes an inspection of sensors, cables and associated connections to meters, corrosion at cable and/or battery ports, battery power capacity, etc. Any problems identified during the visual inspection are reconciled prior to instrument use.

An instrument maintenance/inspection log is maintained on loose-leaf paper and retained in a three-ring binder at the Water Quality Planning Section Office in Concord. The log is arranged in columnar format, with column headings of date of inspection/maintenance, name of instrument, description of problem/maintenance activity, and description of problem reconciliation.

Field instruments are maintained (cleaned) and tested according to manufacturer's specifications (Appendix B). Procedures used to test instruments are those used to calibrate the instruments. Any instruments that are not properly calibrated are re-calibrated according the SOPs. If the second calibration is inadequate, corrective measures shown in Table 15 are employed.

11.5 Field Analytical Inspection and Acceptance Requirements for Supplies

Additional supplies are not anticipated for the ARMP. All necessary supplies exist with the NHDES Watershed Management Bureau, or are provided through the NHDES Laboratory Services Unit. All field analytical equipment and appurtenant supplies are inspected according to methods described throughout Section 11 and associated Appendices.

Table 15[a]. Field Analytical Equipment Maintenance, Testing, and Inspection

Equipment name	Activity	Frequency of activity	Acceptance criteria	Corrective action	Person responsible	SOP Reference (Appendix)
YSI Model 52: Dissolved oxygen and temperature	Maintenance (cleaning); Visual Inspection; Testing (operation)	Twice per year[b], or as needed during sampling season	± 0.2mg/l or ± 2% of saturation, whichever is greater	Replace membrane, batteries; repair cables; clean ports; Recalibrate; Repeat measurement of affected samples or qualify data if analysis cannot be repeated.	Field Technicians	B-14
Orion Model 250A and ATC Triode Model 91-57BN	Maintenance (cleaning); Visual Inspection; Testing (operation)	Twice per year[b], or as needed during sampling season	Slope Range: 92-102%; millivolt range consistent with manufacturer's specifications	Recalibrate according to SOP. If still unacceptable, use new buffer and recalibrate.	Field Technicians	B-15
YSI Model 30: Specific Conductance	Maintenance (cleaning); Visual Inspection; Testing (operation)	Twice per year[b], or as needed during sampling season	Instrument agreement: ± 6.0 µS/cm at specific conductance near 500 µS/cm; ± 3.0 µS/cm at specific conductance below 200 µS/cm	Turn meter "off". Check batteries, check cord and ports, rinse with deionized water. Turn meter "on". If problems persist, use alternate meter.	Field Technicians	B-16
LaMotte Model 2020: Turbidity	Maintenance (cleaning); Visual Inspection; Testing (operation)	Twice per year[b], or as needed during sampling season	Instrument agreement: ± 1.0 NTU	Inspect sample vials; wash and/or replace, if necessary. Inspect standard. Inspect battery power.	Field Technicians	B-17
Hydrolab DataSonde 4a or MiniSonde: Dissolved Oxygen and Temperature	Maintenance (cleaning); Visual Inspection; Testing (operation)	Twice per year[b], or as needed during sampling season	± 0.2mg/l or ± 2% of saturation, whichever is greater	Replace membrane, batteries; repair cables; clean ports; Recalibrate; Repeat measurement of affected samples or qualify data if analysis cannot be repeated.	Program Manager	B-18
Hydrolab DataSonde 4a or MiniSonde: pH	Maintenance (cleaning); Visual Inspection; Testing (operation)	Twice per year[b], or as needed during sampling season	Slope Range: 92-102%; millivolt range consistent with manufacturer's specifications	Recalibrate according to SOP. If still unacceptable, use new buffer and recalibrate.	Program Manager	B-18
Hydrolab DataSonde 4a: Specific Conductance	Maintenance (cleaning); Visual Inspection; Testing (operation)	Twice per year[b], or as needed during sampling season	Instrument agreement: ± 6.0 µS/cm at specific conductance near 500 µS/cm; ± 3.0 µS/cm at specific conductance below 200 µS/cm	Turn meter "off". Check batteries, check cord and ports, rinse with deionized water. Turn meter "on". If problems persist, use alternate meter.	Program Manager	B-18
Hydrolab DataSonde 4a: Turbidity	Maintenance (cleaning); Visual Inspection; Testing (operation)	Twice per year[b], or as needed during sampling season	Instrument agreement: ± 1.0 NTU	Inspect sample vials; wash and/or replace, if necessary. Inspect standard. Inspect battery power.	Program Manager	B-18

[a]Based on EPA-NE Worksheet #19
[b]Before commencement and at conclusion of summer sampling season

12.0 Fixed Laboratory Analytical Method Requirements

This section describes the analytical techniques used by the NHDES Laboratory Services Unit to generate data for the project. Methods are analytical techniques used to identify and quantify the target analytes. Analytical SOPs document how the laboratory will perform a specific analytical method.

12.1 Fixed Laboratory Analytical Methods and SOPs

All samples collected through the ARMP are transported to the NHDES Laboratory Services Unit for analysis. The Laboratory Services Unit uses various analytical instrumentation and associated SOPs, referenced in Table 16, below. A summary of methods is also provided in Table 7. Sample custody, data documentation, and data management procedures are described in Section 10.2 and 10.3 of this QA Project Plan.

Table 16[a]. Fixed Laboratory Analytical Method/SOP Reference Table

Analytical parameter	Reference Number (Appendix)	SOP Title and Revision date/number Name of lab	Instrument
TP	B-1	State of NH Environmental Services Laboratory: Total Phosphorus, Lachat Flow Injection Colorimetry Revision No. 2, Revision Date: 01-28-02	Lachat Flow Injection Analyzer
NO_3+NO_2	B-2	State of NH Environmental Services Laboratory: Lachat Flow Injection Anions: Nitrate, Nitrite, Chloride, and Fluoride (automated Nitrite) Revision No. 2.1 Revision Date: 01-22-02	Lachat Flow Injection Analyzer
TKN	B-3	State of NH Environmental Services Laboratory: Total Kjeldahl Nitrogen, TKN by flow injection colorimetry Revision No. 2.2 Revision Date: 01-22-02	Lachat Flow Injection Analyzer
NH_3	B-4	State of NH Environmental Services Laboratory: Ammonia by flow injection colorimetry Revision No. 2.1 Revision Date: 01-16-02	Lachat Flow Injection Analyzer
BOD_5	B-5	State of NH Environmental Services Laboratory: Biochemical oxygen demand Revision No. 2.4 Revision Date: 04-04-02	Membrane electrode
Hardness	B-6	State of NH Environmental Services Laboratory: Metals by ICP for public drinking water Revision No. 1.9 Revision Date: 01-25-02	ICP

Table 16 (continued). Fixed Laboratory Analytical Method/SOP Reference Table

Analytical parameter	Reference Number (Appendix)	SOP Title and Revision date/number Name of lab	Instrument
Alkalinity	B-7	State of NH Environmental Services Laboratory: Alkalinity Revision No. 4.9 Revision Date: 01-09-02	pH Meter- Orion 710A and Brinkman Digital Buret
TS	B-8	State of NH Environmental Services Laboratory: Total Residue Revision No. 1.4 Revision Date: 01-15-02	Gooches, drying oven, analytical balance
TSS	B-9	State of NH Environmental Services Laboratory: Total non-filterable residue (suspended solids) Revision No. 1.6 Revision Date: 01-15-02	Gooches, drying oven, analytical balance
E. coli	B-10, B-11	State of NH Environmental Services Laboratory: *Escherichia coli* (*E. coli*) by membrane filtration Revision No. 1.3 Revision Date: 03-05-02	Membrane Filter assembly
Aluminum	B-6	State of NH Environmental Services Laboratory: Metals by ICPfor public drinking water Revision No. 1.9 Revision Date: 01-25-02	ICP
Copper	B-12	State of NH Environmental Services Laboratory: Metals by ICP-MS for public drinking water Revision No. 0.4 Revision Date: 01-25-02	ICP-MS
Lead	B-12	State of NH Environmental Services Laboratory: Metals by ICP-MS for public drinking water Revision No. 0.4 Revision Date: 01-25-02	ICP-MS
Zinc	B-12	State of NH Environmental Services Laboratory: Metals by ICP-MS for public drinking water Revision No. 0.4 Revision Date: 01-25-02	ICP-MS
Chlorophyll *a*	B-13	State of NH Limnology Center Laboratory: Chlorophyll *a* Revision Date: 05-25-01	Integrated sampler

[a]Based on EPA-NE Worksheet #20

12.2 Fixed Laboratory Analytical Method/SOP Modifications

Modifications to the fixed laboratory analytical methods/SOPs are not made for the ARMP during the summer monitoring period.

12.3 Fixed Laboratory Instrument Calibration

The NHDES Laboratory Services Unit calibrates all instruments on a daily basis according to SOPs referenced in Table 17, below.

Table 17[a]. Fixed laboratory instrument calibration table

Equipment name and Analyte	Procedure and SOP Reference	Frequency of calibration	Acceptance criteria	Corrective action	Person responsible
ICP Al, Hardness	EPA200.7, DES Sec 10.12c1	daily	cal curve corr. coeff.=/> 0.995	If < 0.995, re-calibrate	Analyst, supervisor
ICP-MS Cu, Pb, Zn	EPA 200.8, DES 10.12d	daily	cal curve corr. coeff.=/> 0.995	If < 0.995, re-calibrate	Analyst, supervisor
Lachat Flow Injection Analyzer TP	EPA 365.2, DES 10.20a	daily	cal curve corr. coeff.=/> 0.995	If < 0.995, re-calibrate	Analyst, supervisor
Lachat Flow Injection Analyzer TKN	EPA 351.2, DES 10.16c	daily	cal curve corr. coeff.=/> 0.995	If < 0.995, re-calibrate	Analyst, supervisor
Lachat Flow Injection Analyzer NH_3	EPA 350.1, DES10.14c	daily	cal curve corr. coeff.=/> 0.995	If < 0.995, re-calibrate	Analyst, supervisor
Lachat Flow Injection Analyzer NO_3+NO_2	EPA 353.2, DES 10.15f	daily	cal curve corr. coeff.=/> 0.995	If < 0.995, re-calibrate	Analyst, supervisor
Gooches, drying oven, analytical balance TS	EPA 160.3 DES 10.21	daily balance check	balance weights must comply with weight tolerances in table[b]	re-calibrate balance if possible, see trouble-shooting guide, call for service	QA officer
Gooches, drying oven, analytical balance TSS	EPA 160.2, DES 10.23	daily balance check	balance weights must comply with weight tolerances in table[b]	re-calibrate balance if possible, see trouble-shooting guide, call for service	QA officer
pH Meter- Orion 710A and Brinkman Digital Buret Alkalinity	EPA 310.1, DES 10.01a	daily pH meter	pH 7 QC= 6.95 to 7.07	re calibrate	Analyst, supervisor
Membrane Filter assembly *E. coli*	SM 9213D.3, 10.43d	N/A	N/A	N/A	N/A
Orion Model 860 Dissolved Oxygen Meter with Probe BOD_5	EPA 405.1, DES 10.02	daily	slope=0.90-1.15	re-calibrate, check probe	Analyst, supervisor

[a]Based on EPA-NE Worksheet #14
[b]Balance Weight Tolerances (see Table 16-A)

Table 18. Acceptable Ranges for Balance Weight Tolerances.

Target Weight (g)	Tolerance Criteria (g)	Agreement Percentage
0.002	0.0018-0.0022	±10%
0.02	0.0198-0.0202	±1%
0.05	0.0495-0.0505	±1%
0.1	0.0999-0.1001	±0.1%
0.5	0.4995-0.5005	±0.1%
1	0.999-1.001	±0.1%
5	4.995-5.005	±0.1%
10	9.99-10.01	±0.1%
20	19.98-20.02	±0.1%
30	29.97-30.03	±0.1%
50	49.95-50.05	±0.1%
100	99.9-100.1	±0.1%
300	299.7-300.3	±0.1%

12.4 Fixed Laboratory Instrument/ Equipment Maintenance, Testing and Inspection Requirements

All instrumentation is inspected prior to use according to methods outlined in the SOPs for individual parameters/instruments. All maintenance activities are documented in maintenance logs. The NHDES Laboratory is a USEPA certified laboratory, and accredited by National Environmental Laboratory Accreditation Conference (NELAC) in September 2001. Accreditation audits were conducted according to the NELAC constitution bylaws and standards dated July 1999 by Charles Dyer (NH Environmental Lab Accreditation Program Manager) and Arthur Clark (EPA-NE). All records of the laboratory audit, including the laboratory instrument/equipment maintenance, testing, and inspection requirements, are available through the NHDES QA Officer or EPA-NE.

12.5 Fixed Laboratory Inspection and Acceptance Requirements for Supplies

All supplies purchased or otherwise acquired by the NHDES Laboratory are inspected prior to use, with purchases being made from reputable companies. Supplies are of adequate quality to sustain confidence in laboratory tests. All supplies must meet bid specifications before being purchased for laboratory use. The laboratory inspects consumables, where practicable, for compliance with standard specifications relative to testing criteria. The NHDES Accounts Payable section of Administrative Services retains records of all purchases for a period of seven years. Chemical purchases are documented in each analytical test preparation book as they are put into service.

The reagent water source is a Millipore Milli-RX Reverse Osmosis / ELIX System that produces high-quality Type II water with resistivity > 15 megOhms. The system is maintained under a service contract with Millipore.

13.0 Quality Control Requirements

This section of the QAPP documents the QC procedures, checks, samples, and acceptance limits used for the ARMP.

13.1 Sampling Quality Control

Duplicate samples are collected throughout the monitoring period. For field duplicates, a second sample is collected (1) concomitant with the final sample of any particular sampling day, or (2) every tenth sample, whichever is first. For example, if eight samples are collected for total phosphorus during a sampling day, a duplicate sample is collected with the eighth sample. However, if 12 samples are collected for total phosphorus during the day, duplicate samples are collected with the tenth and twelfth samples. For field measurement replicates, a second measurement is made (1) concomitant with the final sample of any particular sampling day, or (2) every tenth sample, whichever is first. For example, if eight dissolved oxygen measurements are made during a sampling day, two sequential measurements are made for the eighth measurement. However, if 12 dissolved oxygen measurements are made during the day, two sequential measurements are made with the tenth and twelfth measurements. Duplicate samples are accepted during sampling if (1) each of the two sample collection containers (i.e., two-gallon buckets) are filled at least one-half of their capacities, and (2) samples are appropriately transferred from each of the buckets to the sample storage containers. Duplicate samples are not collected repeatedly from the same sampling location.

Upon receipt of samples at the NHDES Laboratory, a laboratory staff member measures the temperature of the water sample using an infrared thermometer and records the temperature on a login form. This eliminates the need for cooler temperature blanks. Following analysis, all results are transmitted to the Program Manager. The Program Manager accepts laboratory results only if (1) the sample temperature upon receipt at the laboratory approximates the requisite parameter-specific storage temperature (e.g., 1-6^{o}C), or (2) a short time span existed between sample collection and sample receipt to preclude acclimation to the requisite parameter-specific storage temperature. The Program Manager contacts the Laboratory QA Officer to for additional consultation, if necessary.

13.2 Analytical Quality Control

This section of the QAPP identifies the QC procedures, checks, and samples, and their respective acceptance limits that will be used during the project

13.2.1 Field Analytical QC

Field duplicate samples are collected and measurement replicate measurements are made for all field parameters, as described in Section 13.1, above (Table 19). Turbidity and specific conductance measurements are verified through comparisons with field blanks, whereas pH measurements are verified using a known buffer (e.g., pH = 6.0). Dissolved oxygen measurements are verified by comparing the percent of saturation value prior to the sample with the % of saturation after the sample. Data retention for water quality assessment purposes is contingent on compliance with a parameter-specific relative percent difference (RPD) as described in Section 7.2 of this QAPP.

Table 19. Field Analytical QC Sample Table.

Water Quality Parameter	QC Check[a]	QC Acceptance Limit	Corrective Action	Person Responsible for Corrective Action	Data Quality Indicator
Dissolved Oxygen	Field duplicate; Measurement replicate	RPD < 5%	Recalibrate instrument, repeat measurement	Paul Piszczek, Program Manager; or Field Technicians	Precision
	Instrument blank[b]	± 2% of saturation, or ± 0.2 mg/l	Recalibrate instrument, repeat measurement	Paul Piszczek, Program Manager; or Field Technicians	Relative accuracy
Temperature	Field duplicate; Measurement replicate	RPD < 5%	Repeat measurement	Paul Piszczek, Program Manager; or Field Technicians	Precision
pH	Field duplicate; measurement replicate	RPD < 0.2 std units	Recalibrate instrument, repeat measurement	Paul Piszczek, Program Manager; or Field Technicians	Precision
	Known buffer (pH = 6.0)	± 0.2 standard units	Recalibrate instrument repeat measurement	Paul Piszczek, Program Manager; or Field Technicians	Accuracy
Specific Conductance	Field duplicate; measurement replicate	RPD < 5%	Recalibrate instrument, repeat measurement	Paul Piszczek, Program Manager; or Field Technicians	Precision
	Method blank	± 5.0 µS/cm	Recalibrate instrument, repeat measurement	Paul Piszczek, Program Manager; or Field Technicians	Accuracy
Turbidity	Field duplicate; measurement replicate	RPD < 5%	Recalibrate instrument, repeat measurement	Paul Piszczek, Program Manager; or Field Technicians	Precision
	Method blank	± 0.5 NTU	Recalibrate instrument, repeat measurement	Paul Piszczek, Program Manager; or Field Technicians	Accuracy

[a]performed on a frequency of one per sampling day per parameter, or every tenth sample for each parameter, whichever is first
[b]instrument blank = replacing sensor in storage chamber and recording measurement, with subsequent comparison to initial calibration value

13.2.2 Fixed Laboratory QC

Laboratory QC is achieved through various checks, as summarized in Table 20 through Table 34. Complete descriptions, including acceptance criteria, are provided in parameter-specific SOPs in Appendix B. Precision calculations in the laboratory are derived from duplicate sample analysis, where duplicate sample frequency varies according to analyte (e.g., one duplicate for every eight total phosphorus samples). Precision is expressed as ranges (i.e., calculation of difference between actual sample and duplicate sample).

Table 20[a]. NHDES Laboratory Analytical QC: Total Phosphorous (TP)

Analytical Method/SOP Reference: Appendix B-1		**Measurement Performance Criteria: EPA 365.2 by Lachat 10-115-01-1-F**		**Number of Samples: 57**	
Laboratory QC:	**Frequency/ Number**	**Method/SOP QC Acceptable Limits**	**Corrective Action (CA)**	**Person(s) Responsible For CA**	**Data Quality Indicator (DQI)**
Method Blank	1 at beginning, end and every 10 samples	0 to <MDL	Invalidate the run and repeat	Analyst, Inorganic Supervisor, Quality Control Supervisor	Contamination, drift, method performance
Reagent Blank	NA	NA	NA	NA	NA
Instrument Blank	NA	NA	NA	NA	NA
Laboratory Duplicates	1 every 10 samples	Range: 0 – 0.007	Repeat, qualify data	Analyst, Inorganic Supervisor, Quality Control Supervisor	Precision
Laboratory Matrix Spike	1 every 10 samples	77-119%	Repeat, qualify run	Analyst, Inorganic Supervisor, Quality Control Supervisor	Matrix effect
Laboratory Control Sample	1/run	0.100 +/_ 10%	Repeat run	Analyst, Inorganic Supervisor, Quality Control Supervisor	Accuracy
Laboratory Fortified Blank	1/run	0.05 +/_ 10%	Repeat run	Analyst, Inorganic Supervisor, Quality Control Supervisor	Accuracy, method performance
Continuing Calibration Verification (mid-point calibration standard)	1 every 10 samples	0.200 +/- 10%	Repeat run	Analyst, Inorganic Supervisor, Quality Control Supervisor	Drift

[a]based on EPA-NE QAPP worksheet #24a

Table 21. NHDES Laboratory Analysis QC: Nitrate and Nitrite ($NO_3 + NO_2$)

Analytical Method/SOP Reference: Appendix B-2		**Measurement Performance Criteria: EPA 353.2 by Lachat 10-107-04-1-A**		**Number of Samples: 57**	
Laboratory QC:	**Frequency/ Number**	**Method/SOP QC Acceptable Limits**	**Corrective Action (CA)**	**Person(s) Responsible For CA**	**Data Quality Indicator (DQI)**
Method Blank	NA	NA	NA	NA	NA
Reagent Blank	1 at beginning, end, and every 10 samples	0 to <MDL	Invalidate run and repeat	Analyst, Inorganic Supervisor, Quality Control Supervisor	Drift, contamination, method performance
Instrument Blank	NA	NA	NA	NA	NA
Laboratory Duplicates	1 every 10 samples	0 – 0.023 mg/l	Repeat, quantify data	Analyst, Inorganic Supervisor, Quality Control Supervisor	Precision
Laboratory Matrix Spike	1 every 10 samples	92 – 108%	Repeat, quantify data	Analyst, Inorganic Supervisor, Quality Control Supervisor	Matrix interference
Laboratory Control Sample	1/run	2.5 +/- 10%	Repeat run	Analyst, Inorganic Supervisor, Quality Control Supervisor	Accuracy
Laboratory Fortified Blank	1/run	1.5 +/- 10%	Repeat run	Analyst, Inorganic Supervisor, Quality Control Supervisor	Method Performance/ Accuracy
Continuing Calibration Verification (mid-point calibration standard)	1 every 10 samples	6.25 +/- 10%	Re-run	Analyst, Inorganic Supervisor, Quality Control Supervisor	Method Performance/ Accuracy

[a]based on EPA-NE QAPP worksheet #24a

Table 22. NHDES Laboratory Analysis QC: Total Kjeldahl Nitrogen (TKN)

Analytical Method/SOP Reference: Appendix B-3		**Measurement Performance Criteria: EPA 351.2 by Lachat 10-107-06-2-E**		**Number of Samples: 57**	
Laboratory QC:	**Frequency/ Number**	**Method/SOP QC Acceptable Limits**	**Corrective Action (CA)**	**Person(s) Responsible For CA**	**Data Quality Indicator (DQI)**
Method Blank	1 at beginning, end and every 10 samples	0 to <MDL	Invalidate run and repeat	Analyst, Inorganic Supervisor, Quality Control Supervisor	Contamination, method performance, drift
Reagent Blank	NA	NA	NA	NA	NA
Instrument Blank	NA	NA	NA	NA	NA
Laboratory Duplicates	1 every 10 samples	0 – 0.07 mg/l	Repeat, qunalify data	Analyst, Inorganic Supervisor, Quality Control Supervisor	Precision
Laboratory Matrix Spike	1 every 10 samples	75 – 119%	Repeat, qunalify data	Analyst, Inorganic Supervisor, Quality Control Supervisor	Matrix /effect
Laboratory Control Sample	1/run	3.5 +/- 10%	Repeat run	Analyst, Inorganic Supervisor, Quality Control Supervisor	Accuracy
Laboratory Fortified Blank	1/run	1.0 +/- 10%	Repeat run	Analyst, Inorganic Supervisor, Quality Control Supervisor	Accuracy and method performance
Continuing Calibration Verification (mid-point calibration standard)	1 every 10 samples	2.0 +/- 10%	Repeat run	Analyst, Inorganic Supervisor, Quality Control Supervisor	Accuracy and method performance

[a]based on EPA-NE QAPP worksheet #24a

Table 23. NHDES Laboratory Analysis QC: Ammonia (NH3-N)

Analytical Method/SOP Reference: Appendix B-4		**Measurement Performance Criteria: Standard Methods # 4500NH3-B.& G**		**Number of Samples: 57**	
Laboratory QC:	**Frequency/ Number**	**Method/SOP QC Acceptable Limits**	**Corrective Action (CA)**	**Person(s) Responsible For CA**	**Data Quality Indicator (DQI)**
Method Blank	1 at beginning, end and every 10 samples	Must be: 0 to <MDL	Invalidate data run and repeat	Analyst, Inorganic Supervisor, Quality Control Supervisor	Method performance contamination drift
Reagent Blank	NA	NA	NA	NA	NA
Instrument Blank	NA	NA	NA	NA	NA
Laboratory Duplicates	1 every 10 samples	0 – 0.36 mg/l		Analyst, Inorganic Supervisor, Quality Control Supervisor	Precision
Laboratory Matrix Spike	1 every 10 samples	Recovery: 84 – 119%	Re-run, qualify data	Analyst, Inorganic Supervisor, Quality Control Supervisor	Matrix effects (interference)
Laboratory Control Sample	1/run	4.11(+/- 10%) 8.22 (+/- 10%)	Re-analyze a fresh aliquot or Re-run whole run	Analyst, Inorganic Supervisor, Quality Control Supervisor	Accuracy
Laboratory Fortified Blank	1/run	1.0 +/- 10%	Re-analyze a fresh aliquot or Re-run whole run	Analyst, Inorganic Supervisor, Quality Control Supervisor	Accuracy and methods performance
Continuing Calibration Verification (mid-point calibration standard)	1 every 10 samples	10 +/- 10%	Repeat run	Analyst, Inorganic Supervisor, Quality Control Supervisor	Accuracy and methods performance

[a]based on EPA-NE QAPP worksheet #24a

Table 24. NHDES Laboratory Analysis QC: Biochemical Oxygen Demand (BOD_5)

Analytical Method/SOP Reference: Appendix B-5		**Measurement Performance Criteria: Standard Methods # 5210B**		**Number of Samples: 57**	
Laboratory QC:	**Frequency/ Number**	**Method/SOP QC Acceptable Limits**	**Corrective Action (CA)**	**Person(s) Responsible For CA**	**Data Quality Indicator (DQI)**
Method Blank	NA	NA	NA	NA	NA
Reagent Blank (Dilution Water)	1/run	<0.2 mg/l	Report qualified data or invalidate data	Analyst, Inorganic Supervisor, Quality Control Supervisor	Contamination
Instrument Blank	NA	NA	NA	Na	NA
Laboratory Duplicates	1/batch	Range: 0-0.38 mg/l	Report qualified data or invalidate data	Analyst, Inorganic Supervisor, Quality Control Supervisor	Precision
Laboratory Matrix Spike	1/batch per matrix	Recovery: 88% - 131%	Report qualified data or invalidate data	Analyst, Inorganic Supervisor, Quality Control Supervisor	Interferences
Laboratory Control Sample	1/batch	LCS = 3.3 +/- 10%	Report qualified data or invalidate data	Analyst, Inorganic Supervisor, Quality Control Supervisor	Accuracy
Laboratory Fortified Blank	NA	NA	NA	NA	NA
Bottle Blank	1/run	<2 mg/l	Report qualified data or invalidate data	Analyst, Inorganic Supervisor, Quality Control Supervisor	Contamination

[a]based on EPA-NE QAPP worksheet #24a

Table 25. NHDES Laboratory Analysis QC: Hardness

Analytical Method/SOP Reference: Appendix B-6		**Measurement Performance Criteria: EPA 200.7**		**Number of Samples: 57**	
Laboratory QC:	**Frequency/ Number**	**Method/SOP QC Acceptable Limits**	**Corrective Action (CA)**	**Person(s) Responsible For CA**	**Data Quality Indicator (DQI)**
Method Blank	NA				
Reagent Blank	beginning, end, and every 10 samples	<RDL	re-cal, re-run	analyst, Inorganics supervisor, QAO	contamination, drift
Instrument Blank	NA				
Laboratory Duplicates	1 in 10 samples duplicated	range 0-1.51mg/L	repeat sample qualify data	analyst, Inorganics supervisor, QAO	precision
Laboratory Matrix Spike	1 in 10 samples spiked	84-114%	repeat sample qualify data	analyst, Inorganics supervisor, QAO	matrix effects
LCS 38.2mg/L	1 per run	+/-10% 34.4-42.0	re-cal, re-run	analyst, Inorganics supervisor, QAO	accuracy
LFB 53.2 mg/L	1 per run	+/-10% 51.3-57.8	re-cal, re-run	analyst, Inorganics supervisor, QAO	method performance

[a]based on EPA-NE QAPP worksheet #24a

Table 26. NHDES Laboratory Analysis QC: Alkalinity

Analytical Method/SOP Reference: Appendix B-7		**Measurement Performance Criteria: EPA 600/4-79-020, Method 310.1; Standard Method 2320 B (APHA, 1995)**		**Number of Samples: 57**	
Laboratory QC:	**Frequency/ Number**	**Method/SOP QC Acceptable Limits**	**Corrective Action (CA)**	**Person(s) Responsible For CA**	**Data Quality Indicator (DQI)**
Method Blank	NA				
Reagent Blank	beginning of run	<RDL	re-cal, re-run	analyst, Inorganics supervisor, QAO	contamination, drift
Instrument Blank	NA				
Laboratory Duplicates	1 in 10 samples duplicated	range 0-0.42	repeat sample	analyst, Inorganics supervisor, QAO	precision
Laboratory Matrix Spike	NA				
LCS 50 mg/L	beginning and every 10 samples	+/-10% 45.0-55.0	re-cal, re-run	analyst, Inorganics supervisor, QAO	accuracy
LFB	NA				

[a]based on EPA-NE QAPP worksheet #24a

Table 27. NHDES Laboratory Analysis QC: Total Solids (TS)

Analytical Method/SOP Reference: Appendix B-8		**Measurement Performance Criteria:** **EPA 600/4-79-020, Method 160.3; Standard Method 2540 B (APHA, 1995)**		**Number of Samples: 57**	
Laboratory QC:	**Frequency/ Number**	**Method/SOP QC Acceptable Limits**	**Corrective Action (CA)**	**Person(s) Responsible For CA**	**Data Quality Indicator (DQI)**
Method Blank	1 per run, in duplicate	± 5 mg/L	correct results based on blank	analyst, Inorganics supervisor, QAO	drying effectiveness, method performance
Reagent Blank	NA				
Instrument Blank	NA				
Laboratory Duplicates	1 in samples duplicated	0-10.6 RPD	repeat sample qualify data	analyst, Inorganics supervisor, QAO	precision
Laboratory Matrix Spike	NA				
LCS-level varies per lot	1 per run	90-110%	repeat run	analyst, Inorganics supervisor, QAO	accuracy
LFB	NA				

[a]based on EPA-NE QAPP worksheet #24a

Table 28. NHDES Laboratory Analysis QC: Total Suspended Solids (TSS)

Analytical Method/SOP Reference: Appendix B-9		**Measurement Performance Criteria: Standard Methods 2540 D**		**Number of Samples: 57**	
Laboratory QC:	**Frequency/ Number**	**Method/SOP QC Acceptable Limits**	**Corrective Action (CA)**	**Person(s) Responsible For CA**	**Data Quality Indicator (DQI)**
Method Blank	1 per run, in duplicate	± 5 mg/L	correct results based on blank	analyst, Inorganics supervisor, QAO	drying effectiveness, method performance
Reagent Blank	NA				
Instrument Blank	NA				
Laboratory Duplicates	1 in samples duplicated	0-7.9 RPD	repeat sample qualify data	analyst, Inorganics supervisor, QAO	precision
Laboratory Matrix Spike	NA				
LCS-level varies per lot	1 per run	90-110%	repeat run	analyst, Inorganics supervisor, QAO	accuracy
LFB	NA				

[a]based on EPA-NE QAPP worksheet #24a

Table 29. NHDES Laboratory Analysis QC: *E. coli*

Analytical Method/SOP Reference: Appendix B-10, B-11		**Measurement Performance Criteria:** **Membrane Filter Procedure, EPA 600/4-85/076; Standard Method 9213D.3 (APHA, 1995)**		**Number of Samples: 407**	
Laboratory QC:	**Frequency/ Number**	**Method/SOP QC Acceptable Limits**	**Corrective Action (CA)**	**Person(s) Responsible For CA**	**Data Quality Indicator (DQI)**
Method Blank	beginning, end, every 10 samples	No growth	request resamples	microbiology supervisor, QAO	contamination
Reagent Blank	NA				
Instrument Blank	NA				
Laboratory Duplicates	about 5%	not established			precision
Laboratory Matrix Spike	NA				
Laboratory Control Sample	NA				
Laboratory Fortified Blank	NA				

[a]based on EPA-NE QAPP worksheet #24a

Table 30. NHDES Laboratory Analysis QC: Aluminum (Al)

Analytical Method/SOP Reference: Appendix B-6		**Measurement Performance Criteria: EPA 200.7**		**Number of Samples: 62**	
Laboratory QC:	**Frequency/ Number**	**Method/SOP QC Acceptable Limits**	**Corrective Action (CA)**	**Person(s) Responsible For CA**	**Data Quality Indicator (DQI)**
Method Blank	NA				
Reagent Blank	beginning, end, and every 10 samples	<RDL	re-cal, re-run	analyst, Inorganics supervisor, QAO	contamination, drift
Instrument Blank	NA				
Laboratory Duplicates	1 in 10 samples duplicated	range 0-0.228	repeat sample qualify data	analyst, Inorganics supervisor, QAO	precision
Laboratory Matrix Spike	1 in 10 samples spiked	94-109%	repeat sample qualify data	analyst, Inorganics supervisor, QAO	matrix effects
LCS 2.0 mg/L	1 per run	+/-10% 1.80-2.20	re-cal, re-run	analyst, Inorganics supervisor, QAO	accuracy
LFB 0.500 mg/L	1 per run	+/-10% 0.450-0.550	re-cal, re-run	analyst, Inorganics supervisor, QAO	method performance

[a]based on EPA-NE QAPP worksheet #24a

Table 31. NHDES Laboratory Analysis QC: Copper (Cu)

Analytical Method/SOP Reference: Appendix B-12		**Measurement Performance Criteria: EPA 200.8**		**Number of Samples: 71**	
Laboratory QC:	**Frequency/ Number**	**Method/SOP QC Acceptable Limits**	**Corrective Action (CA)**	**Person(s) Responsible For CA**	**Data Quality Indicator (DQI)**
Method Blank	NA				
Reagent Blank	beginning, end, and every 10 samples	<RDL	re-cal, re-run	analyst, Inorganics supervisor, QAO	contamination, drift
Instrument Blank	NA				
Laboratory Duplicates	1 in 10 samples duplicated	duplicate range +/-10%	repeat sample qualify data	analyst, Inorganics supervisor, QAO	precision
Laboratory Matrix Spike	1 in 10 samples spiked	70-130%	repeat sample qualify data	analyst, Inorganics supervisor, QAO	matrix effects
LCS 0.020 mg/L	1 per run	+/-10% 0.018-0.022	re-cal, re-run	analyst, Inorganics supervisor, QAO	accuracy
LFB 0.050 mg/L	1 per run	+/-10% 0.045-0.055	re-cal, re-run	analyst, Inorganics supervisor, QAO	method performance

[a]based on EPA-NE QAPP worksheet #24a

Table 32. NHDES Laboratory Analysis QC: Lead (Pb)

Analytical Method/SOP Reference: Appendix B-12		**Measurement Performance Criteria: EPA 200.8**		**Number of Samples: 62**	
Laboratory QC:	**Frequency/ Number**	**Method/SOP QC Acceptable Limits**	**Corrective Action (CA)**	**Person(s) Responsible For CA**	**Data Quality Indicator (DQI)**
Method Blank	NA				
Reagent Blank	beginning, end, and every 10 samples	<RDL	re-cal, re-run	analyst, Inorganics supervisor, QAO	contamination, drift
Instrument Blank	NA				
Laboratory Duplicates	1 in 10 samples duplicated	duplicate range 0-0.0004 mg/L	repeat sample qualify data	analyst, Inorganics supervisor, QAO	precision
Laboratory Matrix Spike	1 in 10 samples spiked	79-109%	repeat sample qualify data	analyst, Inorganics supervisor, QAO	matrix effects
LCS 0.020 mg/L	1 per run	+/-10% 0.018-0.022	re-cal, re-run	analyst, Inorganics supervisor, QAO	accuracy
LFB 0.050 mg/L	1 per run	+/-10% 0.045-0.055	re-cal, re-run	analyst, Inorganics supervisor, QAO	method performance

[a]based on EPA-NE QAPP worksheet #24a

Table 33. NHDES Laboratory Analysis QC: Zinc (Zn)

Analytical Method/SOP Reference: Appendix B-12		**Measurement Performance Criteria: EPA 200.8**		**Number of Samples: 75**	
Laboratory QC:	**Frequency/ Number**	**Method/SOP QC Acceptable Limits**	**Corrective Action (CA)**	**Person(s) Responsible For CA**	**Data Quality Indicator (DQI)**
Method Blank	NA				
Reagent Blank	beginning, end, and every 10 samples	<RDL	re-cal, re-run	analyst, Inorganics supervisor, QAO	contamination, drift
Instrument Blank	NA				
Laboratory Duplicates	1 in 10 samples duplicated	duplicate range 0-0.035 mg/L	repeat sample qualify data	analyst, Inorganics supervisor, QAO	precision
Laboratory Matrix Spike	1 in 10 samples spiked	74-118%	repeat sample qualify data	analyst, Inorganics supervisor, QAO	matrix effects
LCS 0.020 mg/L	1 per run	+/-10% 0.018-0.022	re-cal, re-run	analyst, Inorganics supervisor, QAO	accuracy
LFB 0.050 mg/L	1 per run	+/-10% 0.045-0.055	re-cal, re-run	analyst, Inorganics supervisor, QAO	method performance

[a]based on EPA-NE QAPP worksheet #24a

Table 34. NHDES Laboratory Analysis QC: Chlorophyll *a* (Chlor *a*)

Analytical Method/SOP Reference: Appendix B-13		**Measurement Performance Criteria: No Reference in Standard Methods**		**Number of Samples: 57**	
Laboratory QC:	**Frequency/ Number**	**Method/SOP QC Acceptable Limits**	**Corrective Action (CA)**	**Person(s) Responsible For CA**	**Data Quality Indicator (DQI)**
Method Blank	10% or weekly	>MDL	Inspect bottles and filtering equipment for contamination	Analyst	Accuracy/Bias (contamination)
Reagent Blank	NA	NA	NA	NA	NA
Instrument Blank	One per analytical shift	N/A	Instrument Correction	Instrument	Accuracy/Bias (contamination)
Laboratory Duplicates	10%	+/- 3 ug/L	Review Bench book sample information	Analyst	Analytical Precision
Calibration Verification Check (Turner Low Cal Standard)	Quarterly	+/- 10%	Reanalyze standard	Analyst	Accuracy/Bias
Calibration Verification Check (NIST Test # SRM2031)	Annual	Within Manufacturer's Tolerance(s)	Adjust as required to meet manufacturer's specifications and tolerances	QAQC Officer	Accuracy/Bias

[a]based on EPA-NE QAPP worksheet #24a

* Note : All the sample is used when running this analysis, therefore, if laboratory duplicates do not meet an acceptance limit there is no recourse, invalidate/exclude the data.

14.0 Data Acquisition Requirements

This section of the QAPP identifies the sources of previously collected data and other information that will be used to make project decisions.

The ARMP is currently the primary mechanism for documenting water quality conditions in rivers and streams throughout the state. The selection of sampling locations during 2002 is based on historical data collected under the program. In addition, data from other programs, such as the Volunteer River Assessment Program (VRAP), may also be used for selecting sampling locations (Table 35). It should be noted that these data are used for guidance purposes only, as reviewed by the Program Manager or other Water Quality Planning Section staff. To date, formal criteria for using VRAP data to determine whether additional sampling under the ARMP should be conducted at VRAP locations have not been developed. The NHDES Watershed Management Bureau is currently developing a methodology for assessing surface water throughout the state, and is anticipated to include formal criteria.

Although data collected through the Ambient Program and VRAP are the primary data sources, other data are collected during the year: (1) response to complaints, (2) conditions in Section 401 Water Quality Certificates, and (3) in support of Total Maximum Daily Load (TMDL) studies. These data are acquired directly through the Water Quality Planning Section, and are used for reference in the context of newly collected data. Ancillary information is also derived from photographs, topographic maps, and Geographic Information System (GIS) thematic layers. Similarly, this information is used for reference only.

Table 35[a]. Non-Direct Measurements Criteria and Limitations Table.

Non-direct measurement (secondary data)	Data source, report date, data generator, data collection dates	How data will be used	Limitations on data use
Water Quality Data	NHDESNHDES Volunteer River Assessment Program (VRAP): 1998-2000	Determine need for additional sampling and/or sampling locations	Requires validation by NHDESNHDES for use in 303(d) list and 305(b) report preparation
Water Quality Data	NHDESNHDES Ambient River Monitoring Program: 1990-2001	Determine need for additional sampling and/or sampling locations	Requires validation by NHDESNHDES for use in 303(d) list and 305(b) report preparation

[a]Based on EPA-NE Worksheet #25

15.0 Documentation, Records and Data Management

This section of the QAPP describes how project data and information will be documented, tracked, and managed from the field to final use and storage in a manner that ensures data integrity and defensibility.

15.1 Project Documentation and Records

The ARMP includes several modes of documentation (Table 36); a STORET-compatible database is used to retain data.

Table 36[a]. Project Documentation and Records Table.

Sample Collection Records	Field Analysis Records	Fixed Laboratory Records	Data Assessment Records
Field Data Sheets	Field Data Sheets	Login and Custody Sheets	Validation/verification Logs
New Hampshire Atlas (monitoring locations displayed)	Site Characterization Sheets	Laboratory Bench Books	Field audit checklists
	Equipment Maintenance, Testing, and Inspection Log	Laboratory Results Printouts (raw data)	

[a]Based on EPA-NE Worksheet #26

15.2 Field Analysis Data Package Deliverables

Field analytical data represent definitive data for the ARMP. Field measurements (e.g., pH, temperature, etc.) are made concomitantly at the time samples are collected for laboratory analysis. Similarly, the sampling site is characterized at the time of sampling relative to general in-channel, riparian, and upland attributes. Field measurement data and sampling site attribute data are recorded on field data sheets and site description sheets. A three-ring binder that includes all field data sheets and site description sheets constitutes the field analysis data package, which is retained in the Water Quality Planning Section office.

15.3 Fixed Laboratory Data Package Deliverables

Fixed laboratory data represent definitive data for the ARMP. The NHDES Laboratory Services Unit provides typed, tabular-formatted analytical results sheets to the Program Manager. Although the laboratory analyses are conducted according to sample holding times, the analytical results are submitted within six months after sample collection. The results sheets represent the sole constituent of the fixed laboratory data package, which is retained in the Water Quality Planning Section office.

15.4 Data Reporting Formats

All field data and information (field measurements, site descriptions, etc.) are recorded in ink on field data sheets. Any recording errors are corrected by placing a single horizontal line through the error and recording the new data next to or above the erroneous record. Field measurement data are entered manually into the NHDES water quality database, whereas laboratory analytical results are entered into the LIMS database.

15.5 Data Handling and Management

The ARMP includes field measurements and laboratory analyses of water quality. Site descriptions accompany the field measurements. Field measurement data are recorded on field data sheets, and subsequently retained in a three-ring binder maintained by the Program Manager. Throughout the monitoring period, field measurement data are entered into the NHDES water quality database, after review by the Program Manager. All data entered into the database are cross-checked against the data on the field data sheets by a second staff member to eliminate data entry errors; data entry errors are immediately corrected. A copy of the site description sheet and field data sheet are given in Appendix C.

Laboratory results are hand-written in bench books, and are subsequently entered into the Laboratory Information Management System (LIMS) database by laboratory personnel. Results are also submitted to the Program Manager for review and entry into the NHDES water quality database. Results are subsequently cross-checked against the data on the results sheets to eliminate data entry errors; data entry errors are immediately corrected.

All data are entered, processed, and analyzed using IBM personal computers supporting the Microsoft (MS) suite of software programs. The NHDES water quality database is maintained on the NHDES computer network, and is secured through daily back-up procedures. Charts, tables, figures, and descriptive statistics (e.g., mean, maximum, minimum, etc.) are generated using MS Excel. Raw data are codified accordingly for use in binomial statistical analysis. Raw data are also extracted from the NHDES water quality database to support the development of the 303(d) list and 305(b) report.

A copy of the field data sheet, site description sheet, laboratory data entry page, NHDES water quality database data entry page, and laboratory results sheet are provided in Appendix C.

15.6 Data Tracking and Control

All data are tracked by the Program Manager and laboratory personnel. The field data sheets are relinquished to the Program Manager for review at the conclusion of each sampling day. Results from laboratory analyses are transferred to bench books, and, subsequently, to the LIMS by laboratory personnel immediately following analysis. The results are subsequently relinquished to the Program Manager for entry into the NHDES water quality database. The field data sheets and laboratory results sheets are retained in the Water Quality Planning Section office. All data remain secure in the LIMS and NHDES water quality databases, which are maintained on the NHDES computer network. Access to the computer network is restricted to staff of the NHDES. Data are retrieved through the use of the query options provided by the database software by the Program Manager and Water Quality Planning Section staff.

16.0 Assessments and Response Actions

This section of the QAPP identifies the number, frequency, and type of planned assessment activities that will be performed for the project.

16.1 Planned Assessments

The ARMP serves as the primary data source for assessing water quality throughout the State of New Hampshire. Therefore, technical systems audits (TSA) are conducted for (1) collection of water samples, (2) use of field instrumentation, (3) documentation of data, and (4) data entry. Technical systems audits are conducted at the conclusion of each sampling month (i.e., final week of June, July, August) for water sample collection, operation of instrumentation, and data documentation. An assessment/audit sheet is used to document the activity (Appendix D). Assessments for data entry are conducted twice during the monitoring season, and coincide with field technicians' availability to perform the activity. The Program Manager accompanies field technicians during water sampling to verify proper sample collection, instrumentation use, and data documentation. The Program Manager reviews data input by the technicians. A formal TSA for all activities is not conducted at the onset of the monitoring season, as an initial training session ensures proper use of instrumentation prior to use during the monitoring period. During the assessments (except for the training session), the Program Manager and field technicians discuss the efficiency and effectiveness of the ARMP protocols. Any substantive changes to the protocols are made consistent with section 4.2.1 of this QAPP.

Planned assessments are not conducted in the laboratory for data collected specifically for the ARMP. However, proficiency testing, replicate testing, and re-testing of retained samples are among the attributes of the laboratory performance audits that are conducted throughout the year.

Table 37[a]. Project Assessment Table.

Assessment Type	Frequency	Person(s) responsible for performing assessment, title and organizational affiliation	Person(s) responsible for responding to assessment findings, title and organizational affiliation	Person (s) responsible for identifying and implementing corrective actions (CA), title and organizational affiliation	Person (s) responsible for monitoring effectiveness of CA, title and organizational affiliation
Field Sampling TSA	Monthly	Paul Piszczek Program Manager: ARMP NHDES	Paul Piszczek Program Manager: ARMP NHDES	Paul Piszczek Program Manager: ARMP NHDES	Paul Piszczek Program Manager: ARMP NHDES
Field Analytical TSA	Monthly	Paul Piszczek Program Manager: ARMP NHDES	Paul Piszczek Program Manager: ARMP NHDES	Paul Piszczek Program Manager: ARMP NHDES	Paul Piszczek Program Manager: ARMP NHDES
NHDES Laboratory Services Fixed Laboratory TSA	Annually in September	Rachael Rainey Laboratory QA/QC Officer NHDES	Rachael Rainey Chem Lab QA/QC Officer NHDES	Rachael Rainey Chem Lab QA/QC Officer NHDES	Rachael Rainey Chem Lab QA/QC Officer NHDES

[a]Based on EPA-NE Worksheet #27b

16.2 Assessment Findings and Corrective Action Responses

Following the completion of field TSAs, the Program Manager identifies any/all inconsistencies between the QAPP and the actual performance of methods outlined in this QAPP and associated SOPs. The Program Manager determines the magnitude of the inconsistencies, and determines the potential for substantive error generated by the inconsistencies. Subsequently, the Program Manager either conditionally retains the data or removes the data from the water quality assessment. The Program Manager also determines (1) whether the QAPP and/or SOPs should be revised due to inefficiency, or (2) whether field technicians require additional training. The Program Manager drafts memoranda that detail the time and extent of inconsistencies, retains the documentation in project files specific to the sampling year, and transmits copies to the NHDES Quality Assurance Manager. Following the completion of laboratory TSAs, the laboratory QA/QC officer identifies discrepancies related to the analytical procedures are recorded on the bench log or data package. The laboratory QA/QC Officer subsequently reviews the bench logs, data package, and Corrective Action forms, and electronically retains Corrective Action forms.

16.3 Additional QAPP Non-Conformances

The Program Manager is notified of any QAPP inconsistencies, and implements necessary corrective actions as soon as possible after identification of the non-conformance. Depending on the magnitude of the non-conformance or the probability for substantive error, the Program Manager determines (1) whether the QAPP and/or SOPs should be revised due to inefficiency, or (2) whether field technicians require additional training. Any changes to this QAPP, as identified as necessary by the Program Manager, are conducted according to Section 4.2 of this QAPP.

17.0 QA Management Reports

Routine Quality Assurance (QA) Management Reports are not written for the ARMP, although an annual QA memorandum is written at the conclusion of the data collection period (i.e., September) (Table 38). This memorandum summarizes the QA activities conducted during that particular year, including

- Summary of QA/QC objectives;
- Description of training activities;
- Conformance to QAPP requirements/procedures, and descriptions of deviations, if any, from the approved QAPP and approved amendments, if any, to the QAPP;
- Limitations of data;
- Documentation of usable data versus amount of data actually collected;
- List of reasons why data are not usable. This includes a review of any of the following
    - Precision
    - Accuracy
    - Representativeness
    - Completeness
    - Comparability
    - Sensitivity
- Limitations on the use of measurement data generation;
- Summary of conflicts, and subsequent resolution of conflicts, associated with sampling; and
- Use and effectiveness of corrective actions, if corrective actions were taken.

Copies of the the memorandum are retained in the NHDES files for reference when preparing the 303(d) list and 305(b) report and transmitted to the NHDES Quality Assurance Manager. ARMP data are consistently reviewed during the sampling period to determine sampling efficiency.

Table 38. QA Management Reports Table

Type of report	Frequency	Person responsible for report prep (name & org.)	Report recipients	Projected delivery date
Memorandum	Annual	Paul Piszczek, NHDES	NHDES-WMB files	September 30 of each year
Memorandum	Annual	Paul Piszczek, NHDES	NHDES Quality Assurance Manager	September 30 of each year

[a]Based on EPA-NE Worksheet #28

18.0 Verification and Validation Requirements

The ARMP is the primary data collection mechanism for conducting statewide water quality assessments in New Hampshire. Therefore, all field and laboratory data and appurtenant documentation are verified and validated prior to use in water quality assessments. However, verification and validation need not be conducted by external entities. The field data collection and field and laboratory data entry activities associated with the ARMP are subject to verification and validation reviews by the Program Manager and field technicians, whereas the analytical procedures performed in the laboratory are verified and validated by the Laboratory QA Manager. Specific procedures are provided in Section 19.0.

19.0 Verification and Validation Procedures

This section of the QAPP describes the process that will be followed to verify and validate project data.

19.1 Verification

Throughout the monitoring period, verification reviews for field-based activities are conducted by the Program Manager to ensure data are collected in accordance with this QA Project Plan and appurtenant SOPs (Table 39). This is achieved through the use of a verification checklist created by the Program Manager, which includes proper documentation of meter calibration data, documentation of data collected during sampling, and appropriate reconciliation of documentation errors during calibration and field activities. A copy of the checklist is provided in Appendix E. At the conclusion of the monitoring period, verification reviews are conducted by the Program Manager to ensure consistency between laboratory samples submitted and laboratory data received.

Verification reviews for laboratory-based activities, including transfer of sample custody, are documented in the NHDES Laboratory Services Unit Quality Systems Manual (QSM) (Appendix F).

Table 39[a]. Data Verification Process

Verification task	Description	Person responsible for verification (name, organization)
Sampling Design	Conformance to the sampling design is verified daily. This includes a comparison of the sampling activities planned for the day against the sampling activities actually conducted. Any inconsistencies are discussed and reconciled prior to the subsequent sampling day if the subsequent sampling day is impacted by the inconsistency. A verification review form is completed, and retained in the ARMP files.	Program Manager NHDES
Field Meter Calibration	Calibration data for each field meter are verified daily according the respective SOPs, where completeness is the primary concern. The verification review ensures that all calibration data have been recorded prior to data collection. Requisite corrective actions are imposed prior the subsequent sampling day. A verification review checklist is used during the review, and retained in the ARMP files.	Field Technicians; Program Manager NHDES
Field Data Sheets	Field data are verified daily according to this QA Project Plan, where completeness and adherence to error reconciliation procedures are the primary concerns. The verification review is conducted at the end of the sampling day, and ensures that field data are appropriately documented on the field data sheets, and that documentation errors are properly reconciled. Requisite corrective actions are imposed prior to the subsequent sampling day. A verification review checklist is used during the review, and retained in the ARMP files.	Program Manager NHDES
Sample Handling	The transfer of custody of each water sample is verified as part of the consistency determination conducted for Laboratory Analysis, and is described, below.	Program Manager NHDES

Table 39 (continued). Data Verification Process

Verification task	Description	Person responsible for verification (name, organization)
Laboratory Analysis	Laboratory data packages are verified internally for completeness prior to transmittal, in accordance with the NHDES Laboratory Services Unit QSM. Verification also includes a consistency determination to ensure that the laboratory transmits results of all samples submitted during the monitoring period. The verification review is documented as a memorandum, and retained in the ARMP files.	Laboratory QA Manager NHDES Program Manager NHDES

[a]Based on EPA-NE Worksheet #29a

19.2 Validation

The ARMP requires several individual validation events relative to the occurrence of Program activities. Validation reviews are conducted internally on a daily and monitoring period basis, and are documented through use of a validation review checklist (Appendix G).

19.2.1 Field Data

Validation reviews for field-generated data are conducted at the end of each sampling day, where the Program Manager reviews calibration data and field sampling data (dissolved oxygen, temperature, pH, specific conductance, turbidity) to ensure data are within the anticipated limits (e.g., pH values must not exceed 14 standard units). The Program Manager screens the data, and discusses any potential outliers with field technicians. The Program Manager validates the data collected for that particular day by signing the data sheets at the conclusion of each sampling day.

Validation reviews for field-generated data are also conducted throughout the monitoring season as data entry activities are conducted. The Program Manager screens the data, and discusses any potential inaccuracies with field technicians. The Program Manager validates the data entered by the field technicians by signing a validation form (Appendix H).

19.2.2 Laboratory Data

Validation reviews for laboratory-generated data are conducted by NHDES Laboratory Services Personnel under the supervision of the Laboratory QA Manager according to methods described in the NHDES Laboratory Services Unit QSM (Appendix F). In addition, after transmittal of laboratory data to the ARMP Manager, a validation review is conducted for any potential outliers. The Program Manager contacts the Laboratory QA Manager to reconcile any inaccuracies. After the conclusion of the monitoring season, the Program Manager authorizes other NHDES Watershed Management Bureau staff to input data to the database. The Program Manager screens the data, and discusses any potential inaccuracies with staff responsible for data entry. The Program Manager validates the data entered by the staff by signing a validation form (Appendix H).

20.0 Data Usability/Reconciliation with Project Quality Objectives

The usability of validated project data is determined through statistical calculations and numerical comparisons with the measurement performance criteria and project quality objectives discussed in Section 7 of this QAPP. The usability assessment is conducted after the conclusion of the monitoring period to consider the overall performance of the monitoring effort. The Program Manager conducts the assessment, and provides tabular, graphical, and textual documentation regarding data quality and usability based on the measures described, below. All data that exceed the limits defined by the individual measures are acknowledged in the data tables through highlighting or shading.

Precision: Field and laboratory-derived data are subject to comparison with duplicate samples throughout the monitoring period. The data must meet the analytical ranges and RPD values defined in Table 6 of Section 7.2.1. As stated in Section 7.2.1, the RPD for field duplicates is determined as

(1)
$$RPD = \frac{|x_1 - x_2|}{\frac{x_1 + x_2}{2}} \times 100\%$$

where x_1 is the original sample concentration
x_2 is the duplicate sample concentration

Accuracy/Bias: Field and laboratory-derived data are subject to comparison with blank and spiked samples throughout the monitoring period. Data from blank and spike samples are compared with the accuracy limits defined in Table 6 of Section 7.2.1.

Sample Representativeness: Field and laboratory data are reviewed relative to the original sampling design. Field sampling audits are used to document representativeness.

Sensitivity and quantitation limits: All field and laboratory data are reviewed relative to the prescribed limits defined in Section 7 of this QAPP.

Completeness: All field and laboratory-derived results are summed to determine the actual number of results obtained relative to the number of results expected, as documented in the original sampling schedule. The difference between the results obtained versus the results expected is documented.

Comparability: All field and laboratory-derived data are assumed comparable unless otherwise determined by the Program Manager and/or NHDES Laboratory QA Officer. This assumption is based on the use of consistent field sampling and field analytical procedures, and consistent laboratory analytical procedures. Any procedural or protocol deviations are reported to the Program Manager.

Data Limitations and Actions: Any data exceeding the limits of the individual measures, above, are disqualified from surface water quality assessments. These data serve as guidance for future monitoring efforts, where the sampling locations from which these data were collected are targeted for additional sampling. The Program Manager reviews all exceedences and determines the need for revisions to the sampling and/or analytical approaches.

21.0 References

U.S. EPA-New England, Region I. 1999. Compendium of Quality Assurance Project Plan Requirements and Guidance. U.S. EPA-New England, Boston, MA.